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**GPO:** Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Give corporate author, title, personal author, and catalog or stock number.

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**See publication:** Articles in journals, papers in proceedings, or chapters in books are found in the publication cited. These publications may be in libraries or purchased from publishers or dealers.

**SAE:** Society of Automotive Engineers, Dept. HSL, 400 Commonwealth Drive, Warrendale, Pa. 15096. Order by title and SAE report number.

**TRB:** Transportation Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

**Corporate author:** Inquiries should be addressed to the organization listed in the individual citation.

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## **ABSTRACT CITATIONS**

# SAMPLE ENTRIES

## FORMAT OF ENTRIES IN HIGHWAY SAFETY LITERATURE

NHTSA accession number ----- HS-013 124  
Title of document ----- **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY MALE AND FEMALE DRIVERS**  
Abstract -----  

The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. The results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.

Personal author(s) ----- by C. R. VonBuseck  
Corporate author (or author's affiliation) ----- General Motors Corp.  
Publication date; pagination ----- 1973? ; 18p  
Supplementary note ----- Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers.(EM-23) BY R. L. Bierley, 1965, are included.  
Availability ----- Availability: Corporate author

NHTSA accession number ----- HS-018 924  
Title of document ----- **NATURAL FREQUENCIES OF THE BIAS TIRE**  
Abstract -----  

The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve a derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influences of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.

Personal author(s) ----- by Masami Hirano; Takashi Akasaka  
Journal citation ----- Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)  
Publication date ----- 1976; 6refs  
Availability ----- Availability: See publication

HS-022 587

### SIMULATION OF DRIVER BEHAVIOUR DURING BRAKING

THE AVAILABILITY OF RELIABLE DATA ON DRIVER BEHAVIOR DURING BRAKING HAS PERMITTED THE VALIDATION OF A SIMPLE MATHEMATICAL MODEL WHICH WAS USED AS THE BASIS OF THE DIGITAL SIMULATION DESCRIBED. THE MODEL, REPRESENTING THE BEHAVIOR OF SKILLED AND UNSKILLED DRIVERS DURING BRAKING, CONTAINS FOUR PRINCIPAL COMPONENTS COVERING MOTION DETECTION AND SENSORY CHARACTERISTICS, LIMB DYNAMICS AND FORCE CHARACTERISTICS, THE BRAKING SYSTEM AND VEHICLE DYNAMICS. THE MODEL EMPLOYS THE FORTRAN-BASED CONTINUOUS SYSTEM SIMULATION LANGUAGE, SLAM, INTENDED FOR USE ON THE KL1900 SERIES OF DIGITAL COMPUTERS. THE DETERMINISTIC MATHEMATICAL MODEL WAS FOUND TO PROVIDE A USEFUL BASIS FOR SIMULATING DRIVER BRAKING PERFORMANCE. RESULTS INDICATED THAT IT IS NECESSARY TO EXTEND THE MODEL TO INCLUDE THE ADAPTATION ABILITY OF THE HUMAN OPERATOR. THE MODEL WAS DESIGNED TO APPLY TO PASSENGER CARS, BUT CAN BE ADAPTED TO COMMERCIAL VEHICLES BY MODIFICATIONS FOR THE BRAKING SYSTEM AND THE VEHICLE'S MASS AND FRICTION.

by D. MCLEAN; T. P. NEWCOMB; R. T. SPURR  
LOUGHBOROUGH UNIV. OF TECHNOLOGY; FERODO LTD., CHAPEL-EN-LE-FRITH, ENGLAND  
Publ: HS-022 566 (I-MECH-E-CONFERENCE-PUBLICATIONS-1976-5), "BRAKING OF ROAD VEHICLES," LONDON, 1977 P197-202  
Rept. No. C41/76; 1977; 11REFS  
PRESENTED AT INSTITUTION OF MECHANICAL ENGINEERS CONFERENCE, LEICS., 23-25 MAR 1976.  
Availability: IN HS-022 566

HS-022 732

### THE DIFFICULTY THAT TRAFFIC SIGNS PRESENT TO POOR READERS. FINAL REPORT

A REVIEW WAS CONDUCTED OF THE LITERATURE RELATING TO POOR READING AND TO TRAFFIC SIGN EVALUATION; AND LABORATORY EXPERIMENTS WERE CARRIED OUT TO PROVIDE DATA ON THE PERFORMANCE OF POOR READERS IN TASKS INVOLVING THE LEGIBILITY, INTERPRETABILITY, AND RETENTION IN SHORT-TERM MEMORY OF TRAFFIC SIGN MESSAGES. (ALTHOUGH SOME AUSTRALIAN ADULTS HAVE SIGNIFICANT DIFFICULTIES WITH READING, VERBAL MESSAGES ARE USED WIDELY IN THE TRAFFIC SIGN SYSTEM.) WHILE THIS STUDY SHOWED THAT ONLY A SMALL PROPORTION (LESS THAN 1.1%) OF ADULTS ARE LIKELY TO BE SO DISABLED IN READING AS TO BE COMPLETELY UNABLE TO READ VERBAL TRAFFIC SIGN MESSAGES, EVIDENCE WAS OBTAINED TO SUPPORT THE REPLACEMENT OF SOME VERBAL SIGNS BY SYMBOLIC SIGNS AT LEAST IN SOME CRUCIAL LOCATIONS. FOR THRESHOLD RECOGNITION, POOR READERS REQUIRED VERBAL SIGNS TO BE 2.4 TIMES

THE SIZE REQUIRED BY CONTROL SUBJECTS. EVEN WITH SYMBOLIC SIGNS, POOR READERS STILL REQUIRED LONGER RECOGNITION TIMES THAN CONTROL SUBJECTS. EVIDENCE WAS ALSO FOUND TO SUPPORT THE USAGE, WHERE APPLICABLE, OF SIGNS CONTAINING EITHER PERMISSIVE INFORMATION, OR A COMBINATION OF PERMISSIVE AND PROHIBITIVE INFORMATION, RATHER THAN PROHIBITIVE INFORMATION ALONE. APPENDED ARE EXPERIMENTAL DATA AND AN EXCURSUS ON THE READING PROCESS.

by J. V. MCCARTHY; E. R. HOFFMAN  
UNIVERSITY OF MELBOURNE, DEPT. OF MECHANICAL ENGINEERING, VIC., AUSTRALIA  
1977; 206P 158REFS  
SPONSORED BY COMMONWEALTH OF AUSTRALIA, DEPT. OF TRANSPORT.  
Availability: COMMONWEALTH OF AUSTRALIA, DEPT. OF TRANSPORT

HS-023 114

### NONWOVEN FABRICS ATTRACT AUTOMAKERS

AUTOMOTIVE FABRICS CAN BE PRODUCED NEARLY INSTANTLY FROM FIBER MATERIAL, WITHOUT TRADITIONAL SPINNING AND WEAVING OPERATIONS. THE ADVANTAGES AND DISADVANTAGES OF VARIOUS NATURAL FIBERS (COTTON, JUTE, WOOL) AND MANMADE FIBERS (RAYON, ACETATE, ACRYLIC, NYLON, OLEFIN, POLYESTER, MODACRYLIC, GLASS) FOR AUTOMOTIVE APPLICATIONS ARE OUTLINED. THE FOLLOWING ARE SPECIFIC APPLICATIONS OF NONWOVEN FABRICS: INTEGRAL PADDED EXTERIOR ROOF COVERING MATERIAL, SUNSHADE PADDING, PADDING FOR EMBOSSED ASSEMBLIES (DOOR), NONDIELECTRIC NEEDLED PADDING (DOOR), POLYESTER FIBER FLUFF (SEATING), VINYL-COATED NONWOVEN NEEDLED FIBER FELTS (SEATING), SEAT BELT IDENTIFICATION LABELS, HIGH-DENSITY RESINATED FIBROUS PADDING, NEEDLED NONWOVEN FLOOR COVERING, NYLON FLEECE (FLOOR), JUTE PADDING AND FORMED FLOOR COVERING, FIBROUS ECOLOPAD (SOUND ABSORBER), NEEDLED RESINATED SOUND ABSORBER, AND TRUNK LININGS.

Publ: AUTOMOTIVE ENGINEERING V86 N5 P58-61 (MAY 1978)  
1978  
BASED ON SAE-780627 "NONWOVENS IN AUTOMOTIVE APPLICATIONS," BY KLAUS B. MOTTE, PRESENTED AT THE PASSENGER CAR MEETING, TROY, MICH., 5-9 JUN 1978.  
Availability: SEE PUBLICATION

HS-023 115

### HYBRID COMPUTER SIMULATES FTP [FEDERAL TEST PROCEDURE DRIVING CYCLE]

A HYBRID COMPUTER HAS BEEN UTILIZED BY GENERAL MOTORS (GM) ENGINEERS TO SIMULATE THE FEDERAL TEST PROCEDURE (FTP) DRIVING CYCLE AT A RATE FOUR TIMES FASTER THAN REAL

TIME. AN ANALOG COMPUTER HANDLES CONTINUOUS SIMULATION CHORES, WHILE A DIGITAL DEVICE TAKES CARE OF COMPUTATIONAL WORK, STORAGE, AND CONTROL. THE HYBRID SYSTEM CAN RUN A COMPLETE FTP CYCLE, FOR EXAMPLE, IN EIGHT MINUTES. IT GIVES AN EFFICIENT SIMULATION OF EMISSIONS AND FUEL ECONOMY TESTING SUFFICIENTLY ROBUST TO STUDY EFFECTS OF VARYING TEST PROCEDURES, VEHICLE CALIBRATIONS, AND PRODUCT MIX. OVER THE YEARS, SEVERAL SIMULATION TOOLS HAVE BEEN PROPOSED FOR PREDICTING SUCH INFORMATION. MOST USE PERFORMANCE MAPS AS THEIR PRINCIPAL BUILDING BLOCKS; THEY SIMULATE OPERATING CONDITIONS BY COMBINING SEQUENCES OF STEADY-STATE TEST RESULTS. THE GM APPROACH IS SIMILAR, BUT IT INCORPORATES MORE TRANSIENT INTERACTION TO BRING THE MODEL CLOSER TO THE REAL SYSTEM. IT IS A SIMULATION OF VEHICLE/DRIVER/DYNAMOMETER INTERACTIONS IN A MACROSCOPIC SENSE, WITH ENOUGH DETAILS INCORPORATED TO ALLOW REASONABLE CONFIDENCE IN THE MODEL'S PREDICTIONS OF ABSOLUTE VALUES AND TRENDS. THE DESIRED SPEED PROFILE IS AN INPUT FORCING FUNCTION TO THE MODEL'S CLOSED-LOOP SECTION. COMPUTED CAR SPEED AND THE DESIRED PROFILE ARE COMPARED, AND ANY DEVIATION ACTS AS INPUT TO THE DRIVER MODEL. THE LATTER RESPONDS WITH OUTPUTS OF THROTTLE AND BRAKE CONTROL. A BRAKE MODEL CONVERTS BRAKE DISPLACEMENT INTO BRAKING TORQUE AT THE DYNOMETER. THROTTLE ANGLE IS CONVERTED TO AN ENGINE TORQUE TRANSMITTED TO THE DRIVE AXLE, WHEELS, AND CHASSIS DYNOMETER THROUGH A MODEL OF EITHER A MANUAL OR AUTOMATIC TRANSMISSION. A CHASSIS DYNOMETER MODEL PERFORMS ITS POWER-ABSORBING ROLE. THE OPEN-LOOP SECTION OF THE MODEL SIMULATES EXHAUST EMISSION AND FUEL ECONOMY CHARACTERISTICS AND CONTROLS THE SAMPLING PROCEDURE. EMISSIONS AND FUEL CONSUMPTION ARE COMPUTED AS FUNCTIONS OF VEHICLE RESPONSE TO CLOSED-LOOP CONTROL. A CONSTANT VOLUME SAMPLER MODEL IS ALSO PART OF THE SYSTEM.

Publ: AUTOMOTIVE ENGINEERING V86 N5 P49-53 (MAY 1978)

1978

BASED ON SAE-780287 "COMPUTER SIMULATIONS OF EMISSIONS AND FUEL ECONOMY," BY WILOVE K. JUNEJA, RICHARD W. VALENTINE, AND WILLIAM J. KELLY, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

#### **GEOMETRY CONTROLS DIESEL EMISSIONS [COMBUSTION CHAMBER]**

FULL-SCALE ENGINE TESTING WAS DONE BY THE PERKINS ENGINE GROUP IN THE DEVELOPMENT OF A DIRECT INJECTION DIESEL ENGINE TO IMPROVE EXHAUST QUALITY. IT WAS DECIDED THAT EXHAUST EMISSION BE REDUCED AT ITS SOURCE, BY ATTENTION TO THE MIXTURE FORMATION AND BURNING PROCESSES INSIDE THE CYLINDER.

ECONOMIC CONSIDERATIONS DIRECTED THE RESEARCH TOWARD WAYS TO INCREASE AIR VELOCITIES AND MODIFY THE MANNER IN WHICH THESE VELOCITIES ARE DISTRIBUTED IN THE COMBUSTION SPACE. A DIRECTED PORT, IN CONJUNCTION WITH A COMBUSTION CHAMBER OF RE-ENTRANT ("SQUISH LIP") FORM, PRODUCED IN-BOWL AIR MOTIONS LIKELY TO BE HIGHLY DISRUPTIVE TO THE FUEL SPRAY AND TO FURTHER THE CHOSEN OBJECTIVES OF REDUCING GASEOUS AND PARTICULATE EMISSIONS AND MAINTAINING COMMERCIAL ACCEPTANCE. PRELIMINARY INVESTIGATIONS SHOWED THAT AN INCREASED MIXING RATE HAD BEEN ACHIEVED WITH THE RE-ENTRANT CHAMBER. IT WAS FELT THAT FURTHER TESTS, WITH THE LEADING DIMENSIONS OF THE CHAMBER AS VARIABLES, WOULD BE OF VALUE. TO DEVELOP AN UNDERSTANDING OF THE BEHAVIOR OF THE RE-ENTRANT CHAMBER IN VARIOUS GEOMETRIC CONFIGURATIONS, A SERIES OF ENGINE TESTS WAS ARRANGED WITH THROAT DIAMETER, COMPRESSION RATIO, FLANK ANGLE, AND "LIP" SHAPE AS VARIABLES. THE EFFECT OF A CENTRALLY DISPOSED PIP WAS ALSO EXAMINED. THE EFFECTS OF THESE VARIABLES ON SPECIFIC FUEL CONSUMPTION, SMOKE, AND NITROGEN OXIDES (NO<sub>X</sub>) EMISSIONS ARE PRESENTED. IT WAS DEMONSTRATED THAT THE RE-ENTRANT CHAMBER CAN BE OPTIMIZED EITHER TO GIVE A LOW NO<sub>X</sub>, OR A LOW SMOKE, HIGH EFFICIENCY RESULT BY CHANGES IN CHAMBER GEOMETRY. THERE HAVE BEEN OTHER DEMONSTRATIONS THAT THE CHAMBER CAN ALSO BE OPERATED IN TURBOCHARGED FORM TO GIVE LOW NO<sub>X</sub> CAPABILITY. A FURTHER DEVELOPMENT IS THE ABILITY TO RUN AT ENGINE AND PISTON SPEED PREVIOUSLY ASSOCIATED WITH AN INDIRECT INJECTION SYSTEM.

Publ: AUTOMOTIVE ENGINEERING V86 N5 P42-7 (MAY 1978)

1978

BASED ON SAE-780113 "CHARACTERISTICS OF THE PERKINS 'SQUISH LIP' DIRECT INJECTION COMBUSTION SYSTEM," BY IAN D. MIDDLEMISS, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

#### **FINITE ELEMENT METHODS REDUCE INTERIOR NOISE [AUTOMOBILE DESIGN]**

FINITE ELEMENT METHODS ARE USEFUL IN MINIMIZING NOISE AND VIBRATION PROBLEMS THAT CAN OCCUR IN THE AUTOMOBILE PASSENGER COMPARTMENT AS THE STRUCTURAL MASS FOR A GIVEN VEHICLE SIZE IS MINIMIZED. THE APPROACH CONSISTS OF COMPUTING THE CONTRIBUTIONS OF BODY PANELS TO INTERIOR NOISE AND MAKING APPROPRIATE ADJUSTMENTS TO REDUCE THE EXCITATION OF THE CAVITY ACOUSTIC MODES. THE STRUCTURAL ANALYST HAS PARTICULAR INTEREST IN THE ROAD NOISE CAUSED BY VIBRATIONS INDUCED BY ROAD ROUGHNESS AND INFLUENCED BY ANY COMPONENT IN THE TIRE, SUSPENSION, FRAME, BODY, AND ACOUSTIC CAVITY SYSTEM. THE SPECTRUM OF ROAD NOISE HAS BEEN FOUND TO BE

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STRONGLY INFLUENCED BY THE VIBRATION CHARACTERISTICS OF THE CAR BODY, PARTICULARLY AT LOW FREQUENCIES IN THE RANGE OF THE FIRST FEW CAVITY RESONANCES. THE VIBRATIONS OF THE CAR BODY DURING TRAVEL OVER A ROUGH ROAD RESULT IN VIBRATIONS OF THE WALL PANELS WHICH ENCLOSE THE PASSENGER COMPARTMENT. THESE VIBRATING PANELS RADIATE NOISE TO THE INTERIOR OF THE COMPARTMENT WHERE THE NOISE CAN BE EITHER AMPLIFIED OR REDUCED BY THE CAVITY ACOUSTIC CHARACTERISTICS. FINITE ELEMENT METHODS CAN BE APPLIED TO EVALUATE THE EFFECT OF THE LOWER FREQUENCY STRUCTURAL MODES AND THE LOWER FREQUENCY CAVITY ACOUSTIC MODES ON NOISE IN THE PASSENGER COMPARTMENT.

Publ: AUTOMOTIVE ENGINEERING V86 N5 P32-7 (MAY 1978)

1978

BASED ON SAE-780365 "AUTOMOBILE INTERIOR NOISE REDUCTION USING FINITE ELEMENT METHODS," BY DONALD J. NEFSKE AND LARRY J. HOWELL, PRESENTED AT SAE CONGRESS, DETROIT, 27 FEB-3 MAR 1978.

Availability: SEE PUBLICATION

HS-023 118

#### **GUIDE TO SOURCES OF INFORMATION ON AUTO DEFECTS**

THIS HANDBOOK IS INTENDED FOR ANYONE SEEKING INFORMATION ON AUTOMOBILE DEFECTS. FIRST, THE FOLLOWING THREE SOURCES ARE BRIEFLY DESCRIBED AND SERVE AS A COMPOSITE INTRODUCTION AND BACKGROUND TO THE FIELD OF AUTO DEFECTS LITIGATION AND LIABILITY: "AUTOMOBILE DESIGN LIABILITY," BY RICHARD M. GOODMAN (1970); "LARSEN V. GENERAL MOTORS CORP." 319 F.2D 495 (8TH CIR. 1968); AND "AMERICAN JURISPRUDENCE, PROOF OF FACTS," SECTION 1 (1965), "AUTOMOBILE DESIGN HAZARDS," BY RALPH NADER. NEXT, THE FOLLOWING SOURCES OF INFORMATION AVAILABLE FROM THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) ARE REVIEWED: RECALL CAMPAIGNS, CONSUMER COMPLAINT LETTERS, DEFECT INVESTIGATIONS, FEDERAL MOTOR VEHICLE SAFETY STANDARDS, COMPLIANCE TESTS, MULTIDISCIPLINARY ACCIDENT INVESTIGATIONS, MANUFACTURERS' SERVICE BULLETINS AND SHOP MANUALS, FATAL ACCIDENT REPORTING SYSTEM (FARS), AND NHTSA ACCIDENT DATA BANK. THIRD, THE FOLLOWING GENERAL SOURCES OF INFORMATION ARE REVIEWED: ATTORNEYS AND EXPERT WITNESSES (CENTER FOR AUTO SAFETY (CFAS) FILES), NATIONAL TECHNICAL INFORMATION SERVICE (NTIS), AMERICAN TRIAL LAWYERS ASSOCIATION (ATLA), INDEPENDENT AUTOMOTIVE RESEARCH CENTERS, SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), PERIODICALS, NATIONAL TRANSPORTATION SAFETY BOARD (NTSB), U.S. CONGRESS, INSURANCE INST. FOR HWY. SAFETY (IIHS), HWY. LOSS DATA INST. (HLDI), AND AUTOMOBILE MANUFACTURERS. THE FOLLOWING INFORMATION IS APPENDED: LIST OF ADDRESSES OF INFORMATION SOURCES (AND TELEPHONE NUMBERS), ORGANIZATIONAL CHART

FOR NHTSA, SAMPLE LIST OF CURRENT (7 MAR 1978) INVESTIGATIONS OF ALLEGED SAFETY RELATED DEFECTS, SAMPLE OFFICE OF DEFECTS INVESTIGATION (ODI) FILE CASE INDEX, PRE-1972 COMPONENT CLASSIFICATION CODES FOR USE BY ODI, SAMPLE OF REVISED COMPONENT CLASSIFICATION CODE, MEMBERS OF VARIOUS SAE "STANDARD-MAKING" COMMITTEES, AND TEXT OF NHTSA REGULATION REGARDING RECORD RETENTION BY AUTO MANUFACTURERS (49 CFR SECTION 576).

by JEAN FALLOW, COMP.

CENTER FOR AUTO SAFETY, 1223 DUPONT CIRCLE BLDG., WASHINGTON, D.C. 20036  
1978; 28P REFS

Availability: CORPORATE AUTHOR

HS-023 119

#### **CORROSION OF MOTOR VEHICLES. CONFERENCE PROCEEDINGS, LONDON, 13-14 NOVEMBER 1974**

IN THIS COMPILATION OF PAPERS ON THE CORROSION OF MOTOR VEHICLES, THE FOLLOWING TOPICS ARE COVERED: ECONOMICS OF CORROSION AND THE CAR; ECONOMIC PHILOSOPHY OF THE VEHICLE MANUFACTURER AS REGARDS CORROSION; CORROSION OF MOTOR VEHICLES--THE USERS' VIEWPOINT; LONG-LIFE CAR RESEARCH PROJECT STUDY; CORROSION IN CARS IN SWEDEN; CORROSION OF MOTOR VEHICLES: SAFETY AND ENVIRONMENTAL FACTORS: THE USER'S VIEW; RESEARCH AIMED TO REDUCE CORROSION CAUSED BY HIGHWAY DE-ICING SALT; ENVIRONMENTAL EFFECTS ON MOTOR VEHICLE CORROSION WORLDWIDE; APPLICATION OF MODERN COATINGS TECHNOLOGY TO THE PAINTING OF MOTOR VEHICLES; CORROSION OF THE EXHAUST SYSTEM; INVESTIGATION OF CORROSION PREVENTIVES FOR THE HOLLOW SECTIONS AND UNDERBODIES OF VEHICLES; INFLUENCE OF SHEET METAL ON THE CORROSION OF MOTOR VEHICLES; USE OF GALVANIZED STEEL AND PAINTS WITH A HIGH CONCENTRATION OF ZINC; ANTICORROSION POLICY OF A MOTOR VEHICLE MANUFACTURER; STAINLESS STEEL EXHAUST SYSTEMS; AND BEHAVIOR OF ALUMINUM IN MOTOR VEHICLES. ALSO INCLUDED ARE DISCUSSIONS OF THE PAPERS, WRITTEN CONTRIBUTIONS, AUTHORS' REPLIES TO DISCUSSIONS, LIST OF DELEGATES, INDEX TO AUTHORS AND PARTICIPANTS, AND SUBJECT INDEX.

INSTITUTION OF MECHANICAL ENGINEERS,  
AUTOMOBILE DIV., LONDON, ENGLAND;  
INSTITUTION OF CORROSION TECHNOLOGY,  
LONDON, ENGLAND; SOCIETY OF CHEMICAL INDUSTRY, LONDON, ENGLAND  
Rept. No. CP18-1974; 1976; 151P REFS  
INCLUDES HS-023 120--HS-023 135.

Availability: SAE

HS-023 120

#### **THE ECONOMICS OF CORROSION AND THE CAR**

ANTICORROSION CRUSADEERS NEED TO GUARD AGAINST THE DANGER OF SPOILING A GOOD CASE THROUGH OVERSTATEMENT AND, IN PARTICULAR, THROUGH THE DISCUSSION OF CORROSION AND ITS

PREVENTION IN TERMS OF ABSOLUTE EVIL AND ABSOLUTE GOOD. THE CASE IS ONE INVOLVING ECONOMICS AND ECONOMICS ADMITS OF NO ABSOLUTES. IN PARTICULAR, THE GAINS ARISING DIRECTLY FROM INCREASED DURABILITY MAY NEED TO BE TRADED OFF AGAINST ANY REDUCTION IN THE RATE AT WHICH TECHNICAL ADVANCE IN MOTOR VEHICLES IS TRANSLATED INTO OPERATIONAL REALITY. REFERENCE TO UNNECESSARY GIMMICKS THE PUBLIC IS PERSUADED TO EMBRACE DOES NOT ADEQUATELY DISPOSE OF THIS POINT, NOR DOES REFERENCE TO THE ADMITTED EXCESSES OF MODERN ADVERTISING AND SALESMANSHIP NECESSARILY DISPOSE OF THE REALITY UNDERLYING THE CONCEPT OF CONSUMER CHOICE. THE PECULIAR STRUCTURE OF DEMAND IN THE MOTOR VEHICLE MARKET IS A FACT OF LIFE AS MUCH AS THE PROCESS OF CORROSIVE DEGRADATION, AND THE REQUIREMENTS OF ONE CANNOT BE ARBITRARILY DISMISSED BECAUSE OF THE REQUIREMENTS OF THE OTHER. THE PRICE DETERMINATION IN THE NEW CAR MARKET IS LARGELY IN THE HANDS OF INDIVIDUALS WHO SELL THEIR CARS WITHIN A FEW YEARS AFTER PURCHASE (I.E. THOSE WHOSE DECISION HORIZONS ARE DISTINCTLY SHORTER THAN THOSE APPROPRIATE TO THE ANTICORROSION CAUSE). THE RESALE MARKET DOES NOT PROVIDE AN EFFICIENT MECHANISM FOR VALUING LONGER-TERM BENEFITS. THE ANTICORROSION LOBBY IS THEREFORE FORCED INTO MAKING A SHORT-TERM ECONOMIC CASE FOR WHAT ARE IN EFFECT LONG-TERM BENEFITS. QUITE APART FROM THE DOMINANT INFLUENCE OF SHORT-TERM CONSIDERATIONS IN THE NEW CAR MARKET, THE FAILURE OF THE INDUSTRY TO ADAPT AS FULLY TO MATERIALS AND TECHNOLOGY WHICH WOULD LENGTHEN THE LIFE OF COMPONENTS (THE EXHAUST SYSTEM BEING THE CLASSIC EXAMPLE) MAY REFLECT A DIVERGENCE BETWEEN COMMERCIAL INTEREST AND CONSUMER INTEREST OF A RATHER INTRACTABLE KIND. FROM THE ECOLOGICAL VIEWPOINT, INCREASING THE LONGEVITY OF THE METALLIC STRUCTURE OF VEHICLES MAY INDEED REDUCE THE RATE OF DEPLETION OF NATURAL RESOURCES, BUT A GENERATION OF GERIATRIC CARS WILL PLACE OTHER STRAINS ON THE ENVIRONMENT WHICH MAY BE MORE COSTLY THAN CORROSIVE DEGRADATION.

by EDWARD NEVIN  
 UNIVERSITY COLL. OF SWANSEA,  
 GLAMORGANSHIRE, WALES  
 Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR  
 VEHICLES," LONDON, 1976 P1-5  
 1976; 4REFS  
 Availability: IN HS-023 119

HS-023 121

#### ECONOMIC PHILOSOPHY OF THE VEHICLE MANUFACTURER AS REGARDS CORROSION

IT IS ASSUMED THAT STEEL WILL CONTINUE TO BE USED FOR MASS PRODUCTION CARS. PERHAPS SOME ADDITIONAL ZINC-COATED STEEL SHEET WILL BE USED WHERE MOST EFFECTIVE, BUT THIS IS NOT A UNIVERSAL ANSWER TO RUST PREVENTION AND

WOULD CERTAINLY ADD TO THE COST OF THE VEHICLE BY SIGNIFICANT AMOUNTS. STAINLESS STEEL SILENCERS MAY HAVE A PART TO PLAY, BUT IT IS PROBABLY BETTER THAT THESE SHOULD BE OPTIONALLY AVAILABLE SO THAT CUSTOMERS CAN CHOOSE WHETHER TO PAY THE HIGH FIRST COST OR NOT. REGULAR CUSTOMER CARE IS PROBABLY THE BEST WAY OF PROTECTING THE INVESTMENT IN A CAR. WAX OR OTHER FLEXIBLE SPRAYED-ON UNDERCOATING, SELECTED SO AS NOT TO AFFECT RUBBER COMPONENTS AND APPLIED AT REGULAR INTERVALS AFTER THOROUGH CLEANING OF THE UNDERSIDE OF THE CAR, IS THE BEST PROTECTION AGAINST SALT COMPOUNDS FROM THE ROADS IN WINTER. GARAGING CARS CAN LEAD TO THEIR MORE RAPID DETERIORATION IF THE ATMOSPHERE IS HUMID, WITHOUT AMPLE CIRCULATION OF FRESH AIR. REGULAR CLEANING IN A CAR WASH IS HELPFUL BUT BEFORE DOING SO THE UNDERSIDE SHOULD BE CLEANED WITH A HIGH PRESSURE HOSE, PAYING PARTICULAR ATTENTION TO AREAS WHERE IT MAY BE POSSIBLE FOR MUD TO BE RETAINED. ALSO IMPORTANT IS THE AVOIDANCE OF WATER INSIDE THE CAR SUCH AS THAT PRODUCED BY MELTING SNOW. MANUFACTURERS ARE TRYING TO FIND WAYS TO IMPROVE CORROSION RESISTANCE WITHOUT HAVING TO RAISE PRICES. THE WIDESPREAD USE OF SALT IN WINTER AND THE LIMITED ATTENTION GIVEN BY CUSTOMERS TO THE UNDERSIDE OF THEIR CARS OFFERS A CHALLENGE TO THE DESIGNER. MONEY IS ALSO NEEDED FOR INVESTMENT AND FOR REGULAR PROTECTIVE MAINTENANCE BY THE CUSTOMER IF THE CORROSION PROBLEM IS TO BE MET.

by H. J. C. WEIGHELL  
 CHRYSLER INTERNATIONAL S.A., COVENTRY,  
 ENGLAND  
 Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR  
 VEHICLES," LONDON, 1976 P6-9  
 1976  
 Availability: IN HS-023 119

HS-023 122

#### CORROSION OF MOTOR VEHICLES--THE USERS' VIEWPOINT

THE NATURE AND CAUSES OF CORROSION OF MOTOR VEHICLES AND THE ECONOMIC AND MARKETING FACTORS OF PROVIDING BETTER CORROSION RESISTANCE ARE BRIEFLY REVIEWED; AND RESULTS OF A TEST PROGRAM TO STUDY CAR CORROSION AND A SURVEY OF MOTOR VEHICLE OWNERS WITH RESPECT TO BODYWORK PROBLEMS WITH THEIR CARS, BOTH CONDUCTED BY THE CONSUMERS' ASSOCIATION (LONDON), ARE PRESENTED. RESULTS FROM THE TEST PROGRAM, WHICH COMPRESSES A NORMAL YEAR'S USE INTO FIVE MONTHS AND SIMULATES A WINTER'S RUNNING ON SALTED ROADS WITH THE VEHICLE BEING INSPECTED AT 10,000 MILES, SHOW THAT FROM 1967 ONWARDS THERE WAS LITTLE EVIDENCE OF A RISE OR DECLINE IN THE EFFECTS OF CORROSION. A TABLE PROVIDES RANKINGS OF VARIOUS MODELS FOR THE YEARS 1967 THROUGH 1973 WITH RESPECT TO DIFFERENT ASPECTS OF CORROSION. ANOTHER TABLE PROVIDES RESULTS OF A 1972 SURVEY OF APPROXIMATELY

MATELY 23,000 VEHICLE OWNERS; THE PERCENTAGES OF PERSONS HAVING BODYWORK PROBLEMS WITH THEIR CARS (LISTED BY MANUFACTURER AND YEAR OF FIRST REGISTRATION (1965-1971)) IN THE PREVIOUS YEAR ARE GIVEN. MODELS INCLUDED AUSTIN, FORD, CHRYSLER, VAUXHALL, FIAT, RENAULT, AND VOLVO. MANUFACTURERS HAVE STRONG DISINCENTIVES FOR MAKING SOME OF THE CHANGES WHICH WOULD IMPROVE CORROSION RESISTANCE (E.G. EXPENSIVE NEW EQUIPMENT, ALTERATION IN PRODUCTION METHODS), AND THE GREATEST AREA FOR COST-EFFECTIVE IMPROVEMENT IN THE CORROSION RESISTANCE OF PRESENT DAY VEHICLES IS CLEARLY IN DESIGN (E.G. ELIMINATION OF WATER OR MUD TRAPS, UNNECESSARY TRIM).

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 1976; 1REF  
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HS-023 123

**LONG-LIFE CAR RESEARCH PROJECT STUDY**

IN REFERENCE TO THE LONG-LIFE CAR RESEARCH PROJECT, AN EXTENSIVE SURVEY OF THE LITERATURE CONCERNING THE AUTOMOBILE INDUSTRY TO DATE AND EXPECTED DEVELOPMENTS IN THE FUTURE IS PRESENTED. THIS REVIEW INCLUDES CONSIDERATION OF THE FOLLOWING TOPICS: CONSERVATION OF ENERGY AND RAW MATERIALS, THE BURDEN ON THE ENVIRONMENT CAUSED BY PRODUCTION AND BY OLD CARS, RECYCLING OF WRECKED CARS, THE LIFE EXPECTANCY OF CARS, THE PRESERVATION OF THE ECONOMY OF PRIVATE TRANSPORTATION, AND RESTRUCTURING OF MANPOWER WITHIN THE AUTOMOBILE INDUSTRY. THE PROPOSAL OF DEVELOPMENT SPECIFICATIONS FOR A LONG-LIFE CAR RESEARCH PROJECT IS BROUGHT INTO DISCUSSION IN CONJUNCTION WITH THE SUGGESTED DOUBLING OF THE AVERAGE LIFE SPAN OF AN AUTOMOBILE. AN ATTEMPT IS MADE TO WEIGH THE ADVANTAGES AND DISADVANTAGES OF THE USE OF DEEP-DRAWN STEEL, COATED DEEP-DRAWN STEEL, STAINLESS STEEL, PLASTICS, AND ALUMINUM ALLOYS IN THE CAR BODYWORK IN THE INTEREST OF PRODUCING A LONG SOUGHT-AFTER CORROSION-RESISTANT BODYWORK.

by R. SCHAEFER  
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 STUTTGART-ZUFFENHAUSEN, WEST GERMANY  
 Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P14-28  
 1976; 233REFS  
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HS-023 124

**CORROSION IN CARS IN SWEDEN**

RESULTS OF WORK BY THE SWEDISH MOTOR VEHICLE INSPECTION CO. AND THE SWEDISH CORROSION INST. IN STUDYING THE WEAR OF PASSENGER CARS,

ESPECIALLY CORROSION, ARE REPORTED. THE INSPECTION COMPANY'S STATISTICAL REPORTS SINCE 1965 HAVE SHOWN HOW DIFFERENT VEHICLE COMPONENTS STAND UP TO WEAR AND ADVANCING AGE IN THE HANDS OF THEIR OWNERS. ALSO, THE COMPANY HAS REPORTED AN INCREASED LIFE EXPECTANCY OF VEHICLES SINCE THE INTRODUCTION OF PERIODIC INSPECTION IN SWEDEN IN 1965. THE STATISTICS HAVE ALWAYS INDICATED CONSIDERABLE DIFFERENCES AMONG THE PASSENGER CARS REVIEWED, ESPECIALLY WHERE CORROSION IS CONCERNED, AS WELL AS AMONG DIFFERENT MODELS FROM THE SAME AUTO MANUFACTURER. IN 1972, A SPECIAL STUDY WAS MADE BY THE INSPECTION COMPANY IN COOPERATION WITH THE SWEDISH CORROSION INST. IN ORDER TO ESTABLISH THE REASONS FOR AND THE NATURE OF CORROSION IN CARS. RESULTS OF THIS ANALYSIS OF RUST DAMAGE SHOWED, AMONG OTHER THINGS, THAT A RELATIVELY SMALL NUMBER OF CHARACTERISTIC TYPES OF CORROSION RECUR IN THE MAJORITY OF CASES, THAT THE CAUSES OF CORROSION ARE THE SAME IN THE MAJORITY OF CARS EXAMINED, THAT CORROSION IS MAINLY CONFINED TO A LIMITED NUMBER OF COMPONENTS IN EACH OF THE CAR MODELS EXAMINED, AND THAT EACH CAR MODEL SEEMS TO HAVE ITS OWN PARTICULAR DISTRIBUTION OF DAMAGE. THE COMMONEST TYPES OF LOCALIZED ATTACK IN CARS INCLUDE CREVICE CORROSION, DEPOSIT ATTACK, CORROSION FATIGUE, PITTING, AND GALVANIC CORROSION. GENERAL CORROSION IN CARS MAINLY OCCURS IN LARGE AREAS OF UNCOATED STEEL, OFTEN IN WHEEL ARCHES WHERE GRAVEL THROWN UP BY THE WHEEL HAS WORN AWAY THE PROTECTIVE SURFACE COATING OF PAINT AND CHASSIS COMPOUND, AND INSIDE CHASSIS MEMBERS AND PILLARS. GENERAL CORROSION MOST COMMONLY OCCURS UNDER THE INFLUENCE OF THE AMBIENT ATMOSPHERE, WITH THE LENGTH OF TIME FOR WHICH THE SURFACE IS WET BEING THE MOST IMPORTANT FACTOR. RUST DAMAGE TO STRUCTURAL PARTS OF THE BODY DOES NOT NORMALLY IMPAIR THE VEHICLE'S SAFETY UNTIL IT IS APPROXIMATELY FIVE YEARS OLD. QUITE FREQUENTLY THE REASONS FOR THE OCCURRENCE OF DAMAGE IN THE SAME COMPONENTS AMONG DIFFERENT VEHICLES OF A CERTAIN MODEL CAN BE ATTRIBUTED TO THE DESIGN OF THE COMPONENTS AND TO THE MANUFACTURING TECHNIQUE. CORRESPONDING STATISTICAL MATERIAL FROM INSPECTIONS MADE IN 1973 AND THE FIRST PART OF 1974 TO THAT OF THE 1972 STUDY CONFIRM THE EARLIER FINDINGS.

by GOSTA E. SVENSON  
 AKTIEBOLAGET SVENSK BILPROVNING,  
 STOCKHOLM, SWEDEN  
 Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P29-34  
 1976; 3REFS  
 Availability: IN HS-023 119

HS-023 125

HS-023 125

#### CORROSION OF MOTOR VEHICLES: SAFETY AND ENVIRONMENTAL FACTORS: THE USER'S VIEW

THE CORROSIVE SALT, SLUSH, AND GRIT WHICH ATTACK THE OUTSIDE OF THE EXHAUST SYSTEM ARE AUGMENTED BY WEAK ACID ATTACK DUE TO THE EXHAUST GASES PASSING THROUGH THE SYSTEM. ULTIMATELY THERE WILL BE A GROWTH IN THE APPLICATION OF STAINLESS STEEL OR AT LEAST A GRADE OF STEEL WHICH HAS LOWER CORROSION TENDENCIES THAN MILD STEEL IN ITS PLAIN OR ALUMINIZED FORM. THE ADOPTION OF AIR POLLUTION CONTROL REGULATIONS OF EVER-INCREASING SEVERITY WILL DEMAND THAT EXHAUST SYSTEMS REMAIN RELATIVELY ROT-PROOF, MORE SO IF A CATALYST TYPE OF CONSTRUCTION IS REQUIRED. THE QUESTION OF THE DEGREE OF IMPORTANCE OF CORROSION AS A CONTRIBUTORY FACTOR TO THE OCCURRENCE OF VEHICLE ACCIDENTS, THE INCREASE IN SEVERITY OF PASSENGER INJURIES DUE TO IT, AND THE COST-EFFECTIVENESS OF REMEDIAL MEASURES ADOPTED BY MANUFACTURERS HAS NOT BEEN SATISFACTORILY ANSWERED TO DATE. DESPITE THE OBVIOUS NEED TO ESTABLISH THE FACTS IN THE HIGHLY COMPLEX AND EMOTIVE AREAS OF TRAFFIC ACCIDENTS AND THEIR CONSEQUENCES, FEW PROPER INVESTIGATIONS OR EXPERIMENTS WHICH CAN THROW LIGHT ON THE IMPORTANCE OF CORROSION AS A CONTRIBUTORY FACTOR HAVE BEEN CARRIED OUT SO FAR. THE FOLLOWING TOPICS ARE REVIEWED WITH RESPECT TO CAR CORROSION AND SAFETY: SAFETY REGULATIONS, BRAKE SYSTEM CORROSION, ANNUAL MILEAGE, BRAKE LINE CORROSION, INTERNAL CORROSION OF BRAKE SYSTEMS, STRUCTURAL CORROSION, THE MANUFACTURERS' RESPONSIBILITY, AND ACCELERATED CORROSION TESTING OF CAR BODIES AND ITS LIMITATIONS. IN SEVERE ACCIDENTS, RUST CAN SUBSTANTIALLY REDUCE THE PROTECTION WHICH A WELL CONSTRUCTED CAR OFFERS ITS OCCUPANTS; AN INTERIM ASSESSMENT OF THE PROBABLE EFFECT OF SEVERE CORROSION BASED ON FIELD STUDIES OF ACTUAL ACCIDENTS AND EXPERIMENTAL CRASHES IS PRESENTED. WITH THE EVER-INCREASING EMPHASIS ON GREATER OCCUPANT SAFETY BEING INCORPORATED INTO THE CAR BODY STRUCTURE AND THE ACCOMPANYING NEW EUROPEAN AND U.S. SAFETY REGULATIONS, NEW CORROSION PROBLEMS ARE LIKELY TO BE POSED. FOR EXAMPLE, SOME OF THE NEW SAFETY SYSTEMS WHICH ARE INTENDED TO LOCK THE DOOR SECURELY INTO THE APERTURES DURING A CRASH APPEAR TO BE DESIGNED WITHOUT ANY CONSIDERATION OF THE WEAKENING EFFECT OF CORROSION OVER A FIVE TO SEVEN YEAR PERIOD OR BEYOND.

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Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P35-42  
1976; 3REFS  
Availability: IN HS-023 119

HSL 78-11

HS-023 126

#### RESEARCH AIMED TO REDUCE CORROSION CAUSED BY HIGHWAY DE-ICING SALT

LABORATORY TESTS IN WHICH CARS WERE INTERMITTENTLY IMMERSSED IN DIFFERENT SOLUTIONS (RAINWATER, BRINES, BRINES WITH POLYPHOSPHATE, AND BRINES WITH TRRL (TRANSPORT AND ROAD RES. LAB.) INHIBITOR BLEND OF SODIUM POLYMETAPHOSPHATE WITH ETHODUOMEEN T13 SHOWED THAT VEHICLES DRIVEN THROUGH INHIBITED SALT SOLUTIONS EXHIBITED ONLY A MARGINAL REDUCTION IN CORROSION COMPARED WITH THOSE DRIVEN THROUGH THE UNINHIBITED SALT SOLUTIONS. THE BASIC REASON FOR THIS RESULT IS THE HIGH LEVEL OF CORROSION CAUSED BY CONCENTRATIONS OF SALT AS LOW AS 0.05%. THIS CONCENTRATION OF SALT IS FOUND IN CAKES OF MUD ON CARS EVEN IN THE SUMMER; TEMPERATURES ARE HIGHER THEN AND SO ARE CORROSION RATES DUE TO SALT. TRIALS CARRIED OUT HAVE SHOWN THAT REGULAR UNDERBODY CAR WASHING IS OF VALUE IN REDUCING CORROSION, AND THE BENEFIT IS INCREASED IF WASHING IS ASSOCIATED WITH THE USE OF THE TRRL CORROSION INHIBITOR. HOWEVER, IT IS TRUE TO SAY THAT AUTO MANUFACTURERS DO NOT IN GENERAL DESIGN CARS THAT CAN BE EFFECTIVELY WASHED UNDERNEATH, AT LEAST NOT BY ANY CONCEIVABLE AUTOMATIC WASH OPERATION. ONE SIMPLE WAY OF REDUCING MUD CAKING AND MAKING UNDERBODY CAR CLEANING EASIER WOULD BE FOR MANUFACTURERS TO USE SMOOTHER RATHER THAN TEXTURED UNDERBODY SEALS. A SERIOUS OBSTACLE TO PROGRESS TOWARD REDUCING MOTOR VEHICLE CORROSION IS THE ABSENCE OF REALISTIC ACCELERATED TESTS BY WHICH IMPROVEMENTS IN ANTICORROSION TECHNIQUES CAN BE EVALUATED.

by R. R. BISHOP  
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Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P43-9  
1976; 10REFS

Availability: IN HS-023 119

HS-023 127

#### ENVIRONMENTAL EFFECTS ON MOTOR VEHICLE CORROSION WORLD WIDE

THE MOST SEVERE CORROSION ENVIRONMENTS ARE IN NORTH AMERICA, SOUTH AMERICA, EUROPE, GHANA, NIGERIA, THE FAR EAST (VIZ. BURMA, VIETNAM, THE ISLANDS OF BORNEO, SUMATRA, ETC.), JAPAN AND NEW ZEALAND. LEAST CORROSIVE ENVIRONMENTS ARE IN SOUTH AFRICA, INDIA, AND AUSTRALIA. MAPS OF THE WORLD ARE PROVIDED WHICH SHOW CORROSION AREAS, AVERAGE NUMBER OF DAYS PER MONTH WITH RAINFALL, TEMPERATURE VARIANTS, AVERAGE RELATIVE HUMIDITY, AND COINCIDENCE OF CORROSION AREAS AND MOTOR VEHICLE MARKETS. ANOTHER MAP SHOWS CORROSION AREAS OF GREAT BRITAIN. TA-

BLES PROVIDE DATA ON DE-ICING SALT USAGE IN WINTER 1969-1970 IN THE U.S., CANADA, AND GREAT BRITAIN, AND THE AVERAGE DAILY READING OF SULFUR DIOXIDE CONCENTRATION IN THE ATMOSPHERE OF LONDON AND MAJOR INDUSTRIAL AREAS OF BRITAIN FOR THE PERIOD MAR 1971-APR 1972. CORROSION IS A NATURAL PHENOMENON AND ITS SEVERITY VARIES WITH THE ENVIRONMENT. CLIMATE CAN PRODUCE SEVERE CORROSION, BUT THE POLLUTION OF THE ATMOSPHERE TOGETHER WITH THE SALTING OF ROADS IS PRODUCING INCREASINGLY ADVERSE CONDITIONS IN WHICH VEHICLES OPERATE; THIS IS FURTHER AGGRAVATED BY THE EFFECTS OF STONE DAMAGE. VEHICLE MANUFACTURERS' TEST AND DEVELOPMENT PROGRAMS, TOGETHER WITH IMPROVED POLLUTION CONTROLS, HAVE RESULTED IN INCREASED VEHICLE LIFE EXPECTANCY WHILE PROVIDING AN ECONOMICALLY ACCEPTABLE PRODUCT. HOWEVER, RESEARCH AND DEVELOPMENT EFFORTS MUST CONTINUE SINCE INCREASED SALT USAGE AND CHANGES IN MANUFACTURING PROCESSES, AGRICULTURAL CHEMICALS, ETC., COULD AFFECT THE OVERALL ENVIRONMENT.

by D. T. BULL; C. E. SONNENSTEIN  
VAUXHALL MOTORS LTD., LUTON, ENGLAND  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P50-5  
1976; 13REFS  
Availability: in HS-023 119

HS-023 128

#### THE APPLICATION OF MODERN COATINGS TECHNOLOGY TO THE PAINTING OF MOTOR VEHICLES

IT IS GENERALLY AGREED THAT AS FAR AS STRUCTURAL OR SAFETY ASPECTS ARE CONCERNED, PRESENT DAY METHODS OF PAINTING GIVE ADEQUATE BUT NOT OPTIMUM CORROSION PROTECTION WHEN MEASURED ON A COST/PERFORMANCE BASIS. ON MANY MOTOR VEHICLES, HOWEVER, THERE DOES APPEAR TO BE A PROBLEM WITH UNSIGHTLY COSMETIC CORROSION WHICH, UNLIKE STRUCTURAL CORROSION, IS THE TYPE MOST OFTEN REFERRED TO BY THE AVERAGE AUTOMOBILE OWNER WHEN COMPLAINING OF BODY RUSTING. STONE CHIP DAMAGE IS VERY DEPENDENT ON BOTH THE ELECTROCOAT PRIMER AND SURFACER. THE DIFFERENCE IN STONE CHIP RESISTANCE BETWEEN ALKYD AND ACRYLIC TOP COATS IS NOT AS PRONOUNCED OR AS IMPORTANT AS TOP COAT FILM THICKNESS. FOR EXAMPLE, BOTH TYPES OF POLYMERS AT FILM THICKNESSES OF LESS THAN 1.5 MILS SHOW VARIABLE STONE CHIPPING RESULTS AND METALLIC TOP COATS AT LESS THAN 1.25 MILS SHOW VERY INFERIOR RESULTS AFTER FLORIDA EXPOSURE. STONE CHIPPING FOLLOWED BY SALT SPRAY-HUMIDITY CYCLE TESTS, TO DEVELOP FILIFORM CORROSION OF THE VARIOUS SYSTEMS USED BY EUROPEAN CAR MANUFACTURERS, SHOW DISTINCTLY DIFFERENT RESULTS. SYSTEMS THAT FAIL AT THE SUBSTRATE INTERFACE (FOR WHAT-EVER REASONS) ALL SHOW THE SYMPTOMS OF COSMETIC CORROSION WHILE THOSE THAT FAIL

EITHER AT THE ELECTROCOAT PRIMER-SURFACER OR SURFACER-TOP COAT INTERFACER SHOW IMPROVED CORROSION RESULTS. SHOULD THE INVERSION PROCESS FIND EXTENSIVE COMMERCIAL APPLICATION IT WILL BE NECESSARY TO DESIGN SYSTEMS THAT FAIL AT THE TOP COAT-SURFACER INTERFACE IN ORDER TO AVOID CORROSION PROBLEMS. IT IS SUGGESTED, THEREFORE, THAT IF COSMETIC CORROSION IS TO BE MINIMIZED, AUTO MANUFACTURERS MUST PAY MORE ATTENTION TO STONE CHIP TEST RESULTS. IT MAY BE ARGUED THAT THE SUGGESTION OF DELIBERATELY DESIGNING A WEAKNESS WITHIN THE COATING SYSTEM IS NOT IDEAL; UNFORTUNATELY, UNTIL THE PAINT INDUSTRY CAN DESIGN COATINGS THAT WILL BE UNDAMAGED BY PROJECTILES (STONES) STRIKING THE COATING AT SPEEDS OF UP TO 100 MPH, IT IS THE ONLY WAY TO MINIMIZE COSMETIC CORROSION.

by GORDON PHILLIPS  
AULT AND WIBORG PAINTS LTD., GREENFORD, ENGLAND  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P56-9  
1976; 5REFS  
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HS-023 129

#### CORROSION OF THE EXHAUST SYSTEM

THE TYPICAL AUTOMOBILE EXHAUST SYSTEM IS DESCRIBED, AS ARE THE THREE GENERAL TYPES OF MUFFLERS USED: ABSORPTION (STRAIGHT-THROUGH TYPE), MECHANICAL (BAFFLE TYPE), AND A COMBINATION OF ABSORPTION AND MECHANICAL. EXTERNAL CORROSION IS CAUSED BY CONDENSATION FORMING ON THE SYSTEM AS IT COOLS DOWN AND BY WATER AND DIRT THROWN UP OFF THE ROAD BY THE WHEELS; ALSO, DE-ICING CHEMICALS (SODIUM CHLORIDE AND CALCIUM CHLORIDE) USED ON ROADS IN THE WINTER ARE CORROSIVE TO EXHAUST SYSTEMS. INTERNAL CORROSION IS AGAIN CAUSED BY CONDENSATION, BUT HERE IT IS CONTAMINATED BY ACID PRODUCTS OF COMBUSTION (NITRIC ACID, SULFURIC ACID, SULFURIC ACID, HYDROBROMIC ACID), THE INTERNAL SURFACES OF THE EXHAUST SYSTEM BEING EXPOSED TO A PARTICULARLY CORROSIVE ENVIRONMENT. THE CORROSION OF THE INDIVIDUAL COMPONENTS OF THE EXHAUST SYSTEM (DOWNPIPE, FRONT MUFFLER, OVER-AXLE PIPE, REAR MUFFLER, TAILPIPE) IS DISCUSSED. PHOTOGRAPHS ARE USED TO ILLUSTRATE THE EXAMINATION OF A USED EXHAUST SYSTEM TO ASSESS ITS DURABILITY. MATERIALS USED FOR THE CONSTRUCTION OF EXHAUST SYSTEMS IN THE PAST INCLUDED MILD STEEL FOR MUFFLERS AND STEEL OR COPPER FOR EXHAUST PIPES. CURRENTLY, MILD STEEL AND ALUMINIZED MILD STEEL ARE USED. IN THE FUTURE, COATINGS APPLIED TO MILD STEEL, STAINLESS STEEL, PLASTICS, AND CERAMICS WILL BE USED. GENERAL AND ACCELERATED DURABILITY TESTING OF EXHAUST SYSTEMS DEVELOPED BY FORD MOTOR CO. TO ENSURE EXHAUST SYSTEMS

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HSL 78-11

SATISFY REQUIREMENTS PRIOR TO PRODUCTION ARE DESCRIBED.

by G. E. CAYLESS  
FORD MOTOR CO. LTD., LAINDON, ENGLAND  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P60-5  
1976; 2REFS  
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HS-023 130

#### **AN INVESTIGATION OF CORROSION PREVENTIVES FOR THE HOLLOW SECTIONS AND UNDERBODIES OF VEHICLES**

A RANGE OF COMMERCIALLY AVAILABLE CORROSION PREVENTIVES FOR THE HOLLOW SECTIONS AND UNDERBODIES OF MOTOR VEHICLES WERE TESTED WITH RESPECT TO THEIR RELATIVE PERFORMANCE AND IN COMPARISON WITH A TYPICAL BITUMEN-TYPE UNDERBODY PROTECTIVE. PROTECTION OF THE VISIBLE UNDERBODY AREAS OF VEHICLES BY THICK FILMS OF BITUMEN-BASED MATERIALS MAY BE SAID TO HAVE BECOME TRADITIONAL, BUT DURING THE PAST FEW YEARS A GREATER AWARENESS OF THE DANGERS AND COSTS OF CORROSION HAS LED TO THE DEVELOPMENT OF PROTECTIVE FILM-FORMING COMPOUNDS WHICH CAN BE APPLIED TO THE NORMALLY INACCESSIBLE ENCLOSED SPACES AFTER CONSTRUCTION IS COMPLETE. THEY DRY TO PRODUCE FILMS A MERE FRACTION OF THE THICKNESS OF THE CONVENTIONAL UNDERBODY PROTECTIVES. THESE NEWER MATERIALS WERE INVESTIGATED WITH RESPECT TO THE FOLLOWING PROPERTIES: FLASH POINT AND SOLIDS CONTENT, VISCOSITY, APPLICATION PROPERTIES, DRYING TIME, RESIDUAL TACK, SAGGING, WATER DISPLACING PROPERTIES, CREVICE PENETRATION, STABILITY TO SOLVENT VAPOR, RESISTANCE TO HEAT, CORROSIVITY, FREEDOM FROM STAINING, RESISTANCE TO CONTINUOUS SALT SPRAY, RESISTANCE TO SALT WATER IMMERSION, RESISTANCE TO HIGH HUMIDITY, RESISTANCE TO ABRASION, ADHESION AT LOW TEMPERATURE (RESISTANCE TO IMPACT), AND FIRE RESISTANCE. THE RESULTS INDICATE A WIDE SPECTRUM OF PHYSICAL PERFORMANCE AND SUGGEST THE DESIRABILITY OF A SPECIFICATION TO ASSURE A CERTAIN LEVEL OF DESIRABLE PROPERTIES. THE PROTECTION OFFERED BY THE RELATIVELY SOFT PRESERVATIVES TESTED IS OF A HIGH ORDER IN MOST CASES AND PROMISES A CONSIDERABLY EXTENDED LIFE FOR MOST MOTOR VEHICLES, IF APPLIED IN THE HOLLOW SECTIONS AND UNDERBODIES. FURTHERMORE, THEY OFFER THE PROSPECT OF IMPROVED PROTECTION COMPARED WITH THE TRADITIONAL MATERIAL AT A CONSIDERABLE SAVING IN WEIGHT, PROVIDED THAT THEIR SOMEWHAT PROLONGED TACK RETENTION CAN BE ACCOMMODATED. THE USE OF THESE MATERIALS WITH THEIR EASE OF APPLICATION, STRONG ADHERENCE TO SUBSTRATES, AND TOLERANCE OF MINIMAL PRETREATMENT OF THE SUBSTRATE PRIOR TO APPLICATION CAN BE ATTRACTIVE IN OTHER FIELDS SUCH AS AIR FRAME

SECTIONS AND THE INTERIOR OF BOX-SECTION BRIDGES.

by M. J. GREEN  
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Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P66-72  
1976  
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HS-023 131

#### **THE INFLUENCE OF SHEET METAL ON THE CORROSION OF MOTOR VEHICLES**

EARLIER RESEARCH HAS DEMONSTRATED THAT DIFFERENCES IN THE CORROSION RESISTANCE OF STEEL SURFACES WERE THE RESULT OF CARBON CONTAMINATION. THIS DETRIMENTAL CARBON ON THE STEEL SURFACE WAS DUE TO THE CRACKING OF OIL DURING THE ANNEALING PROCESS. IT HAD BEEN THOUGHT THAT ANNEALING RESIDUES COULD BE REMOVED ONLY BY THE FOLLOWING METHODS: PICKLING WITH NITRIC ACID, SANDBLASTING, OR GRINDING, I.E. PROCESSES BY MEANS OF WHICH THE METAL SURFACE IS ABRADED TO A CERTAIN EXTENT. RESEARCH HAS SHOWN, HOWEVER, THAT METAL LOSS MUST BE RATHER UNIFORM TO OBTAIN MORE CONSTANT CORROSION RESISTANCE VALUES. ELECTROLYTICAL CLEANING PRIOR TO ANNEALING OR OPEN COIL ANNEALING HAS BEEN PROVED TO PRODUCE CLEANER STEEL SURFACES AND LED TO BETTER CORROSION RESISTANCE VALUES. DIFFERENCES IN PROTECTION AGAINST CORROSION HAVE ALSO BEEN SHOWN TO DEPEND ON THE PAINT SYSTEM. DIFFERENT METHODS WILL HAVE TO BE FOUND AND EVALUATED TO AMELIORATE CORROSION PROTECTION IN THE STEEL-PHOSPHATE COATING-PAINT SYSTEM.

by E. BRONDER  
METALLGESELLSCHAFT A.G., FRANKFURT/MAIN,  
WEST GERMANY  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P73-7  
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#### **THE USE OF GALVANIZED STEEL AND PAINTS WITH A HIGH CONCENTRATION OF ZINC [MOTOR VEHICLES]**

GALVANIZED STEEL AND PAINTS WITH A HIGH CONCENTRATION OF ZINC ARE USED BY VOLVO IN THE CONSTRUCTION OF ITS AUTOMOBILES, SINCE ZINC-COATED STEEL, E.G. HOT DIP GALVANIZED STEEL, CORRODES MUCH LESS RAPIDLY THAN STEEL ITSELF. SOME OF THE DISADVANTAGES OF USING HOT DIP GALVANIZED STEEL CONCERN SPOT WELDING. BASED ON A TEST SERIES OF 500 CAR BODIES, WHEN ZINC-COATED STEEL IS WELDED, 50%-60% LONGER MACHINE TIME IS NECESSARY, 25%-40% HIGHER CURRENT, AND ABOUT 50% HIGHER PRESSURE ON THE ELECTRODES. WHEN WELDING ZINC TO STEEL THE ELECTRODES HAVE TO BE ADJUSTED BY FIL-

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ING TWICE AS OFTEN AS FOR STEEL TO STEEL, AND FOR ZINC TO ZINC, EIGHT TIMES. HOT DIP GALVANIZED STEEL IS ALSO MORE EXPENSIVE THAN STEEL; BUT IN PLACES WHERE STEEL COULD NOT BE PROTECTED AGAINST CORROSION, THE USE OF THIS MATERIAL WAS THE ONLY TECHNICAL SOLUTION AVAILABLE AT THE TIME. ALSO, CAR BODIES COMPOSED OF STEEL AND GALVANIZED STEEL CANNOT BE PHOSPHATED WITH THE SAME CHEMICALS AS STEEL ALONE. THE AMOUNT OF ZINC-COATED STEEL HAS DECREASED IN THE MODERN VOLVO BECAUSE OF THE USE OF ELECTROCOATING. HOT DIP GALVANIZED STEEL WILL CONTINUE TO BE USED, HOWEVER, IN THE BODIES OF MOTOR VEHICLES FOR A LONG TIME. THE USE OF ZINC-RICH PRIMERS IS ALMOST PROBABLY ALSO NECESSARY ON SPOT-WELDED SURFACES, AND STEEL PRECOATED WITH ZINC-RICH PRIMERS AND SIMILAR COATINGS WILL QUITE CERTAINLY INCREASE VERY RAPIDLY IN USE.

by PER-AKE WALLGREN  
AKTIEBOLAGET VOLVO, GOTHENBURG, SWEDEN  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P78-80  
1976

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HS-023 133

#### THE ANTI-CORROSION POLICY OF A MOTOR VEHICLE MANUFACTURER

DESIGN AND TESTING, MATERIALS (MILD STEEL, ZINC PRIMERS AND COATED MILD STEEL, ALUMINUM AND ALLOYS, PLASTICS), AND PROTECTION OF MILD STEEL (PHOSPHATING, PRIMING AND PAINTING, OIL WAX INJECTION) ARE SEPARATELY CONSIDERED AS FACTORS IN CORROSION OF MOTOR VEHICLES. EACH YEAR NEW LEGISLATION IS INTRODUCED TO IMPROVE SAFETY, MINIMIZE NOISE, REDUCE EMISSIONS, AND IN FUTURE, POSSIBLY TO REDUCE FUEL CONSUMPTION; BUT THESE MEASURES WILL BE GREATLY DILUTED IN AN AGING CAR POPULATION WHICH IS INCREASING CONTINUOUSLY. AN ALTERNATIVE TO THIS DILEMMA IS A MINIMUM-COST CAR WITH A LIMITED LIFE AND A HIGH POTENTIAL FOR RECYCLING OF MATERIAL, AND POSSIBLY OF SOME COMPONENTS.

by J. F. WALLACE  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P81-6  
1976

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HS-023 134

#### STAINLESS STEEL EXHAUST SYSTEMS [CORROSION]

LABORATORY TESTS AND ROAD TRIALS WERE MADE ON THE CORROSION AND OXIDATION OF STAINLESS STEELS TO INVESTIGATE THEIR POTENTIAL FOR USE IN MOTOR VEHICLE EXHAUST SYSTEMS AND EMISSION CONTROL DEVICES. CORROSION IS A DOMINANT FAILURE MECHANISM IN MILD STEEL

EXHAUST SYSTEMS (FOUR OUT OF FIVE CASES), AND THE WORK WAS CARRIED OUT TO DEVELOP STAINLESS STEEL SYSTEMS WITH EXTENDED SERVICE LIVES. THE LABORATORY TESTING HAS SHOWN THAT A 12% CHROMIUM STEEL IS LIKELY TO EXTEND THE LIFE OF CONVENTIONAL EXHAUST SYSTEMS VERY CONSIDERABLY. ROAD TRIALS, ON A LIMITED BASIS BUT BEING EXTENDED TO BE MORE COMPREHENSIVE, HAVE SHOWN THAT STAINLESS STEEL EXHAUST SYSTEMS HAVE A LONG SERVICE LIFE. RIG TESTING OF MATERIALS FOR EMISSION CONTROL DEVICES SUGGESTS THAT A 12% CHROMIUM STEEL WILL BE SUITABLE FOR METAL TEMPERATURES UP TO 700° C, BUT ABOVE THIS TEMPERATURE MORE HIGHLY ALLOYED STAINLESS STEELS ARE REQUIRED.

by A. M. EDWARDS; R. A. E. HOOPER; J. B. MARRIOTT  
BRITISH STEEL CORP., SPECIAL STEELS DIV.,  
ROTHERHAM, YORKS., ENGLAND  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR VEHICLES," LONDON, 1976 P87-94  
1976; 5REFS

Availability: IN HS-023 119

HS-023 135

#### THE BEHAVIOUR OF ALUMINIUM IN MOTOR VEHICLES

A CASE HISTORY IS RECORDED FOR BRIGHT-TRIM ALUMINUM COMPONENTS IN MOTOR VEHICLE SERVICE FOR 12 YEARS, AFTER WHICH TIME A VARIETY OF ANODIZED ALUMINUM ALLOY COMPONENTS ON THE STANDARD PRODUCTION CAR WERE IN EXCELLENT CONDITION WITH NO SIGNIFICANT DETERIORATION TO EITHER THE ANODIZED ALUMINUM OR TO THE OTHER MATERIALS SUCH AS THE PAINTED STEEL BODYWORK, IN CONTACT WITH THE ALUMINUM. THE ONLY EVIDENCE OF ANY DETERIORATION OF THE ALUMINUM TRIM WAS OF A VERY MINOR CHARACTER CONSISTING OF A DARKENING OF THE ALUMINUM IN ISOLATED SCRATCHES WHERE THE ANODIC FILM HAD BEEN REMOVED BY MECHANICAL DAMAGE, AND A SLIGHT GALVANIC CORROSION OF THE ALUMINUM OCCURRING AT CONTACTS WITH RUSTY STEEL RIVETS IN THE RADIATOR-GRILLE ASSEMBLY. RESULTS OF EXPOSURE TESTS ON A BRIGHT-TRIM ALLOY IN A VARIETY OF ATMOSPHERES UNDER VARYING CONDITIONS OF ANODIC FILM THICKNESS AND CONTACTS WITH OTHER MATERIALS ARE GIVEN. RESULTS ARE BY NECESSITY OF A RELATIVE NATURE, BUT INDICATE THE GOOD BEHAVIOR OF FILMS IN THE THICKNESS RANGE AROUND 5 MILLIMICRONS WHEN CONSIDERED IN THE CONTEXT FOR CAR TRIM WITH A SERVICE LIFE OF AROUND TEN YEARS AND AT LEAST SOME CLEANING DURING THAT TIME. RESULTS ARE ALSO GIVEN FOR CORROSION TESTS CARRIED OUT FOR 6.5 YEARS ON ALLOYS DEVELOPED FOR BODYWORK ON VEHICLES. THE CORROSION RESISTANCE OF THE MATERIALS TESTED INDICATES A MARKED PREFERENCE FOR TWO ALUMINUM ALLOYS COMPARED WITH MILD STEEL WHEN EVALUATED IN EITHER THE UNPAINTED OR PAINTED CONDITION AND WHEN EVALUATED IN TERMS OF APPEARANCE, GENERAL CORROSION, LOSS OF METAL, DEPTH OF

ATTACK, OR LOSS OF STRENGTH. WHEN COMPARING THE TWO ALUMINUM ALLOYS, THE BA304 (ALUMINUM-COPPER-MAGNESIUM) IS SOMEWHAT INFERIOR TO THE BA27 (ALUMINUM/MAGNESIUM) IN THE UNPAINTED CONDITION, BUT SIMILAR WHEN PAINTED. THE GOOD PERFORMANCE OF UNPAINTED BA304 AFTER EXPOSURE FOR 5.75 YEARS IN A SEVERE MARINE ATMOSPHERE INDICATES A VERY LONG POTENTIAL LIFE AS PAINTED BODY SHEET. AN ALUMINUM ALLOY CHASSIS WAS EXAMINED AFTER 15 YEARS' SERVICE, AND SEVERE CORROSION AT DIRECT GALVANIC CONTACTS WAS CONSIDERED TO BE REMEDIABLE BY A MORE SELECTIVE CHOICE OF ALLOYS AND ASSEMBLY PROCEDURE. AN ALUMINUM RADIATOR WAS SHOWN TO PERFORM SATISFACTORILY FOR 19 MONTHS (20,000 MILES) IN NORMAL SERVICE IN CONJUNCTION WITH A CAST-IRON ENGINE.

by P. A. HAINES; D. J. SCOTT; E. W. SKERRY  
BRITISH ALUMINIUM CO. LTD., GERRARDS CROSS,  
ENGLAND  
Publ: HS-023 119 (CP18-1974), "CORROSION OF MOTOR  
VEHICLES," LONDON, 1976 P95-104  
1976; 26REFS

Availability: IN HS-023 119

#### HS-023 137

#### A THREE-WAY CATALYTIC MUFFLER USING PROGRESSIVE AIR INJECTION FOR AUTOMOTIVE EXHAUST GAS PURIFICATION

A THREE-WAY CATALYTIC MUFFLER FOR REDUCING AUTOMOTIVE EMISSIONS (NITROGEN OXIDES (NO<sub>X</sub>), HYDROCARBONS (HC), AND CARBON MONOXIDE (CO)) IS DESCRIBED WHICH DOES NOT REQUIRE A VERY PRECISE ADJUSTMENT OF THE ENGINE EQUIVALENCE RATIO OR CONSTANT CONTROL OF THE SUPPLY OF SECONDARY AIR UPSTREAM FROM THE CONVERTER. THE SYSTEM CONSISTS OF A CONVERTER IN WHICH SECONDARY AIR IS SUPPLIED FROM MULTIPLE POINTS WITHIN THE CATALYST BED ITSELF IN ORDER TO HAVE AN OXYGEN CONCENTRATION IN THE TREATED EXHAUST GAS THAT INCREASES PROGRESSIVELY BETWEEN THE INLET AND THE OUTLET. EXPERIMENTAL CATALYTIC CONVERTER DESIGNS ARE PRESENTED FOR MONOLITHIC OR BEAD-TYPE CATALYSTS. THE NUMEROUS ADVANTAGES OF THIS SINGLE-BED CATALYST SYSTEM AS COMPARED WITH THE DUAL-BED SYSTEM ARE DESCRIBED. IN PARTICULAR IT IS SHOWN THAT THE NO REDUCTION RATE IS INCREASED ON PRECIOUS METAL CATALYSTS WHEN OXYGEN IS ADDED TO SOME EXTENT IN A REDUCING EXHAUST GAS, WITH MAXIMUM EFFICIENCY BEING REACHED JUST BELOW THE STOICHIOMETRIC PROPORTION. AMMONIA FORMATION DUE TO THE PRESENCE OF OXYGEN IS ALSO REDUCED IN THE FIRST PART OF THE CATALYTIC BED, AND ITS REOXIDATION IN THE OXIDIZING SECTION IS DIRECTED TOWARD N<sub>2</sub> (NITROGEN) FORMATION SINCE OXYGEN IS ONLY IN GREAT EXCESS NEAR THE OUTLET. RESULTS OF ENGINE BENCH TESTS SHOW THAT THE RATIO BETWEEN THE FLOW OF EXHAUST GAS AND THE SECONDARY AIR MAY VARY WIDELY WITH LITTLE CHANGE IN THE EFFICIENCY OF THE

SYSTEM. PRELIMINARY VEHICLE TESTS, USING THE CVS (CONSTANT VOLUME SAMPLING) PROCEDURE, CONFIRM THESE RESULTS.

by M. PRIGENT; B. RAYNAL; P. COURTY  
INSTITUT FRANCAIS DU PETROLE, SOCIETE  
PROCATALYSE, FRANCE  
Rept. No. SAE-770298; 1977; 11P 13REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

#### HS-023 142

#### SUMMARY OF THE AUTOMOTIVE THEFT SURVEY. A JOINT PROJECT BETWEEN GENERAL MOTORS CORPORATION AND SEVERAL AUTOMOTIVE INSURANCE COMPANIES

DATA FROM 16,619 THEFT SURVEY REPORTS RECEIVED FROM 13 U.S. INSURANCE COMPANIES PARTICIPATING IN AN AUTOMOTIVE THEFT SURVEY ARE SUMMARIZED. ALL THEFTS DURING A 60-DAY PERIOD IN 1977 WERE REPORTED. DETAILED CONCLUSIONS ARE LIMITED TO GENERALIZATIONS SINCE THE DATA HAVE NOT BEEN NORMALIZED TO REFLECT HOW MANY OF AN INDIVIDUAL MANUFACTURER'S VEHICLES WERE IN THE PARTICULAR POPULATION WHEN THE SURVEY WAS CONDUCTED. IN GENERAL, PASSENGER CAR THEFTS OUTNUMBERED LIGHT-DUTY TRUCK THEFTS BY MORE THAN 6:1, PARTIAL THEFTS ACCOUNTED FOR 72% OF ALL THEFTS REPORTED, TOTAL THEFTS WERE DIVIDED ALMOST EVENLY BETWEEN CASES WHERE THE VEHICLE WAS RECOVERED AND WHERE IT WAS NOT, TOTAL THEFTS WERE A SIGNIFICANTLY SMALLER PERCENTAGE OF ALL THEFTS FOR NEWER CARS (I.E. ONE TO THREE YEARS OLD) THAN THOSE FOUR YEARS OR OLDER, AND 60% OR MORE OF THE CARS RECOVERED HAD PARTS REMOVED. FOR PASSENGER CARS, NEARLY 60% OF THE IDENTIFIABLE TOTAL THEFTS WHERE THE CAR WAS RECOVERED INDICATED THAT THE IGNITION LOCK CYLINDER WAS DEFEATED; TOTAL THEFT WAS SUCCESSFUL IN APPROXIMATELY 77% OF THE CASES IN WHICH THE IGNITION LOCK CYLINDER WAS IDENTIFIED AS BEING INVOLVED; AND AN UNLOCKED PASSENGER COMPARTMENT WAS INDICATED IN APPROXIMATELY 15% OF THE IDENTIFIABLE CASES. MORE THAN 50% OF THE IDENTIFIABLE ENGINE COMPARTMENT THEFTS INVOLVED AN OUTSIDE HOOD RELEASE; THE FOUR MOST PREVALENT METHODS OF ACCESSING THE PASSENGER COMPARTMENT, ACCOUNTING FOR 80% OF THE ENTRIES, WERE BY LIFTING THE DOOR LOCK BUTTON, BREAKING GLASS, NORMAL ENTRY, AND DEFEATING THE DOOR LOCK CYLINDER; AND THE FOUR MOST PREVALENT METHODS OF ACCESSING THE TRUNK/CARGO COMPARTMENT, ACCOUNTING FOR ALMOST 90% OF THE ENTRIES, WERE BY ATTACKING THE LOCK CYLINDER, PIERCING THE SHEET METAL TO GET AT THE LOCK OR ITS LINKAGE, PRYING THE SHEET METAL, AND USING THE OWNER'S KEY. FOR LIGHT-DUTY TRUCKS, JUST OVER 50% OF THE IDENTIFIABLE TOTAL THEFTS WHERE THE TRUCK WAS RECOVERED INDICATED THAT THE IGNITION

LOCK CYLINDER WAS DEFEATED; TOTAL THEFT WAS SUCCESSFUL IN APPROXIMATELY 77% OF THE CASES IN WHICH THE IGNITION LOCK CYLINDER WAS IDENTIFIED AS BEING INVOLVED; AN UNLOCKED PASSENGER COMPARTMENT WAS INDICATED IN ONLY 11% OF THE IDENTIFIABLE CASES; MORE THAN 90% OF THE IDENTIFIABLE ENGINE COMPARTMENT THEFTS INVOLVED AN OUTSIDE HOOD RELEASE; AND THE TWO MOST PROMINENT METHODS OF ACCESSING THE PASSENGER COMPARTMENT, ACCOUNTING FOR MORE THAN 58% OF THE ENTRIES, WERE PRYING THE VENT GLASS OR ASSEMBLY, AND BREAKING THE GLASS.

by R. W. BOAK; B. J. RILEY; C. T. TERRY  
GENERAL MOTORS CORP., ENVIRONMENTAL ACTIVITIES STAFF, GENERAL MOTORS TECHNICAL CENTER, WARREN, MICH. 48090  
1978; 117P

Availability: CORPORATE AUTHOR

HS-023 143

**EXHAUST GAS BEHAVIOR OF INTERNAL COMBUSTION AND CHARGE LAYER ENGINES WITH OPERATION WITH METHANOL  
(ABGASVERHALTEN VON OTTO- UND SCHICHTLADEMOTOREN BEI BETRIEB MIT METHANOL)**

THE POSSIBILITY OF USING METHANOL IN VARIOUS COMBINATIONS WITH GASOLINE WAS INVESTIGATED USING AN INTERNAL COMBUSTION ENGINE, AN ENGINE WITH A LEAN FUEL/AIR MIXTURE, AND AN ENGINE WITH A CHARGE LAYER CHAMBER SYSTEM (CCS). ON THE BASIS OF THE RESEARCH, NO COMBUSTION PROBLEMS SHOULD BE ENCOUNTERED IN UTILIZING METHANOL IN AN INTERNAL COMBUSTION ENGINE. THE PHYSICOCHEMICAL CHARACTERISTICS OF METHANOL HAVE A FAVORABLE EFFECT ON THE COMBUSTION SEQUENCE, AND IT SEEMS APPROPRIATE TO OPTIMIZE THE STRUCTURAL AND OPERATIONAL CHARACTERISTICS OF THE INTERNAL COMBUSTION ENGINE WITH RESPECT TO THE SPECIFIC PROPERTIES OF METHANOL. THE ENGINE WITH A LEAN FUEL/AIR MIXTURE REPRESENTS A STEP IN THIS DIRECTION IN THAT AN INCREASED COMPRESSION RATIO AND EXTENSIVE TURBULENCE IN CHARGING, TOGETHER WITH THE SUITABLE COMBUSTION CHARACTERISTICS OF METHANOL, PERMIT TROUBLE-FREE ENGINE OPERATION. OF PARTICULAR INTEREST IS THE USE OF METHANOL IN THE CCS OR TORCH IGNITION ENGINE WITH AN UNFLUSHED AUXILIARY CHAMBER. WHEN SUPPLYING THE AUXILIARY CHAMBER WITH METHANOL, IT IS POSSIBLE TO INJECT CONSIDERABLY LARGER QUANTITIES INTO THE AUXILIARY CHAMBER THAN FOR PURE GASOLINE OPERATION. ALONG WITH A SLIGHT INCREASE IN PERFORMANCE AND EFFICIENCY, THE MAIN EFFECT OF USING METHANOL IN THE CCS ENGINE WAS THE CONSIDERABLE REDUCTION OF NITROGEN OXIDES (NO<sub>x</sub>) EMISSIONS WHEN THE ENGINE WAS OPERATED WITH STOICHIOMETRIC OR LEAN MIXTURES. THIS REDUCTION WAS THE RESULT OF THE REACTION MECHANISMS OF

METHANOL COMBUSTION, A LOWER NITROGEN CONCENTRATION IN THE COMBUSTION CHAMBER, AND LOWER PEAK COMBUSTION TEMPERATURES. ALTHOUGH MANY QUESTIONS MUST STILL BE CLARIFIED BEFORE METHANOL CAN BE MORE WIDELY USED AS A FUEL FOR COMBUSTION ENGINES, ITS PROPERTIES MAKE IT A VERY ATTRACTIVE SOLUTION FOR FUTURE ENGINE DESIGNS WITH REGARD TO ENVIRONMENTAL AND ENERGY REQUIREMENTS.

by DUSAN GRUDEN; GUENTHER HOECHSMANN  
PORSCHE A.G., ENTWICKLUNGSZENTRUM,  
WEISSACH, GERMANY  
1977; 23P 5REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 144

**USE OF ETHYL ALCOHOL FROM BIOMASS AS AN ALTERNATIVE FUEL IN BRAZIL (ANWENDUNG VON AETHYLALKOHOL AUS BIOMASSE ALS ALTERNATIVKRAFTSTOFF IN BRASILIEN)**

THE FOLLOWING ASPECTS OF THE USE OF ETHYL ALCOHOL AS AN ALTERNATIVE VEHICLE FUEL IN BRAZIL ARE TREATED: GEOGRAPHY OF THE COUNTRY, THE ENERGY CRISIS, THE USE OF ETHYL ALCOHOL AS A FUEL IN THE PAST (DATING FROM THE 1920'S), THE NATIONAL ALCOHOL PROG. TO INCREASE THE PRODUCTION OF ALCOHOL, SOURCE CROPS (SUGAR CANE AND MANIOC), ALCOHOL AND PETROCHEMISTRY, ENERGY BALANCE OF ALCOHOL PRODUCTION, AND RESEARCH WITH PURE ETHANOL ENGINES. ON THE BASIS OF THE RESEARCH ON ETHANOL, IT IS CONCLUDED THAT ETHYL ALCOHOL IS THE BEST ALTERNATIVE ENGINE FUEL FOR BRAZIL'S FUTURE. SINCE THE PRODUCTION OF ETHANOL FROM AGRICULTURAL PRODUCTS IS ALREADY BEING DONE ON A LARGE SCALE IN BRAZIL AND SINCE BRAZIL REPRESENTS ONE OF THE MOST FAVORABLE REGIONS IN THE WORLD FOR THE PRODUCTION OF SUCH CROPS AS SUGAR CANE AND MANIOC, THE ADVANTAGES OF ETHANOL AS AN ENGINE FUEL ARE ESPECIALLY APPARENT FOR THIS COUNTRY. CURRENT STUDIES WITH THE ETHANOL ENGINE HAVE DEMONSTRATED THE USEFULNESS OF THIS ALTERNATIVE FUEL. PROBLEMS THAT DO EXIST WITH RESPECT TO ETHANOL FUEL CAN BE OVERCOME OR MINIMIZED WITH EXISTING TECHNOLOGY.

by H. HEITLAND; H. W. CZASCHKE; N. PINTO VOLKSWAGEN DO BRASIL, SAO PAULO, BRAZIL  
1977; 21P 8REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 145

**INTRODUCTION TO MOTOR TRAFFIC: EMS, AN EDUCATIONAL PROGRAM FOR 14-18 YEAR OLDS. FOUNDATIONS-OBJECTIVESPLANNING**

FOLLOWING A DISCUSSION OF THE INVOLVEMENT (IN GERMANY) OF YOUNG DRIVERS IN TRAFFIC ACCIDENTS, INFORMATION ON THE WORK BEING DONE ON A PROJECT TO DEVELOP AN "INTRODUCTION TO MOTOR TRAFFIC" EDUCATIONAL PROGRAM FOR 14-18 YEAR OLDS IS PRESENTED. STATISTICS FOR 1970-1976 SHOW THAT FOR THE 18-20-YEAR-OLD GROUP, THE NUMBER OF PERSONS KILLED OR INJURED IN TRAFFIC ACCIDENTS (IN RELATIONSHIP TO THE NUMBER WHO POSSESSED DRIVER'S LICENSES) ALMOST DOUBLED. THE CAUSE OF THIS HIGH INVOLVEMENT OF YOUNG DRIVERS IN TRAFFIC ACCIDENTS IS NOT ONLY THE LACK OF DRIVING EXPERIENCE BUT ALSO THE MANNER OF BEHAVIOR ASSOCIATED WITH YOUNG PEOPLE. THERE EXISTS A DISCREPANCY BETWEEN GENERAL STANDARDS OF THE ACHIEVEMENT-ORIENTED SOCIETY (E.G. TO ASSERT ONE'S SELF, TO BE MORE SUCCESSFUL THAN OTHERS) AND DESIRABLE TRAFFIC BEHAVIOR (E.G. CONSIDERATION OF OTHERS, DEFENSIVE DRIVING). DESPITE THE FACT THAT MOST YOUNG PEOPLE EXPRESS A POSITIVE BASIC ATTITUDE TOWARD TRAFFIC, THEIR ACTUAL BEHAVIOR IN TRAFFIC SITUATIONS DEVIATES FROM THE ACCEPTED STANDARDS. THE TYPICAL PERSONALITY CHARACTERISTICS OF YOUNG PEOPLE (E.G. WILLINGNESS TO TAKE RISKS, SELF-ASSERTION, REJECTION OF AUTHORITY) CAUSE YOUNG PEOPLE TO OBSERVE TRAFFIC RULES LESS STRICTLY THAN OTHER DRIVERS. FURTHERMORE, YOUNG DRIVERS CONFORM TO THE BEHAVIORAL STANDARDS OF THEIR PEERS WHICH SERVE TO INCREASE PROBLEM BEHAVIOR, PARTICULARLY IN GROUP SITUATIONS. THIS SITUATION SUGGESTS THAT EFFORTS WITH REGARD TO DRIVER EDUCATION BE ROOTED IN A GENERAL EDUCATION PLAN, IN A LONG-TERM EDUCATIONAL PROCESS. THIS EDUCATION PLAN WOULD NOT ONLY INSTRUCT IN THE RULES OF TRAFFIC AND DRIVING SKILLS BUT WOULD ALSO SERVE PRINCIPALLY TO MOLD ATTITUDES WITH AN EMPHASIS ON SAFETY AND/OR THE CORRECTION OF ATTITUDES WHICH ARE DETRIMENTAL TO SAFETY. IT IS SUGGESTED THAT AN INTEGRATED PROGRAM OF DRIVER EDUCATION BY DRIVING SCHOOLS AND BY ELEMENTARY AND SECONDARY SCHOOLS BE IMPLEMENTED TO MEET THESE OBJECTIVES. THE DEVELOPMENT OF THE "INTRODUCTION TO MOTOR TRAFFIC" EDUCATIONAL PROGRAM FOR 14-18 YEAR OLDS IN GERMANY IS DISCUSSED IN TERMS OF PAST WORK, CURRENT ACTIVITIES, OBJECTIVES, STRUCTURE, AND IMPLEMENTATION (FIRST PART SCHEDULED FOR 1978-79 SCHOOL YEAR).

by G. EDELMANN; H. ENGELS; H. C. HEINRICH; J. LANGOSCH; T. MERTENS; I. PFAFFEROTT; R. WAKENHUT; K. H. WALTER; H. WUHRER  
FEDERAL TRAFFIC INST., EMS GROUP, MUNICH,  
GERMANY  
1977; 17P  
PRESENTED AT INTERNATIONAL SYMPOSIUM ON  
ALCOHOL FUEL TECHNOLOGY--METHANOL AND  
ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.

ENGLISH TRANSLATION OF ORIGINAL GERMAN TEXT.

Availability: REFERENCE COPY ONLY

HS-023 146

**FORMAL LECTURE ON THE OCCASION OF THE INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY (FESTVORTRAG ANLASSLICH DES INTERNATIONAL SYMPOSIMUM ON ALCOHOL FUEL TECHNOLOGY)**

WORLDWIDE ENERGY SOURCES IN THE NEXT 50 YEARS, WITH PARTICULAR REFERENCE TO WEST GERMANY, ARE DISCUSSED. WEST GERMANY IS ONE OF MANY PARTIES WHICH WILL BE COMPETING FOR THE USE OF THE DWINDLING SUPPLIES OF NATURAL GAS AND PETROLEUM AS ENERGY SOURCES. IN ADDITION TO THE WESTERN INDUSTRIALIZED COUNTRIES WHICH PRESENTLY TRADE ALMOST EXCLUSIVELY ON THE WORLD PETROLEUM MARKET, THE UNDERDEVELOPED COUNTRIES, DURING THEIR SUBSEQUENT ECONOMIC DEVELOPMENT, WILL CLAIM AN EVER-INCREASING PORTION OF THE AVAILABLE PETROLEUM. CAREFUL CONSIDERATION SHOWS THAT IN THE ADVANCED COUNTRIES ON THE WHOLE A DOUBLING OF THE DEMAND FOR PRIMARY ENERGY IN THE NEXT 50 YEARS CAN BE EXPECTED ALTHOUGH THE POPULATION WILL INCREASE VERY LITTLE IN THESE COUNTRIES. THIS INCREASE, WHICH VASTLY EXCEEDS THE ALREADY HIGH CONSUMPTION OF TODAY, IS DUE AMONG OTHER THINGS TO THE FACT THAT THE REPLACEMENT OF NATURAL ENERGY SOURCES BY "ARTIFICIAL" ONES WILL LEAD TO A GREATER PRIMARY ENERGY CONSUMPTION OF COAL AND NUCLEAR ENERGY. THE CONSUMPTION OF ENERGY IN THE UNDERDEVELOPED AND PARTIALLY DEVELOPED COUNTRIES CAN BE EXPECTED TO INCREASE SIX-FOLD TO TEN-FOLD (FOR 70 COUNTRIES, ENERGY CONSUMPTION IS CURRENTLY LESS THAN 5%, CITIZEN FOR CITIZEN, OF THAT OF WEST GERMANY). IT MAY BE ASSUMED THAT THE CONSUMPTION OF PRIMARY ENERGY OVERALL IN THE NEXT 50 YEARS WILL REACH APPROXIMATELY 25-30 TERAWATT YEARS PER YEAR. WITHIN THE NEXT 50 YEARS, PETROLEUM AND NATURAL GAS MUST BE REPLACED BY OTHER FORMS OF ENERGY, AND A FUNDAMENTAL CHANGE IN THE STRUCTURE OF ENERGY CONSUMPTION WILL BE REQUIRED THROUGHOUT THE WORLD. EVEN THEN, HOWEVER, THIS STRUCTURE WILL VARY GREATLY IN THE INDIVIDUAL COUNTRIES AND REGIONS OF THE WORLD. ONE OF MANY POSSIBLE ALTERNATIVE STRUCTURES FOR SUPPLYING WEST GERMANY WITH ENERGY 50 YEARS FROM NOW IS PRESENTED.

by EDUARD PESTEL  
NIEDERSACHSEN MINISTER FUR WISSENSCHAFT  
UND KUNST, GERMANY

1977; 33P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON  
ALCOHOL FUEL TECHNOLOGY--METHANOL AND  
ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

November 30, 1978

HS-023 149

HS-023 147

**PROBLEMS OF THE USE OF ETHANOL AS A FUEL FOR COMMERCIAL VEHICLES (PROBLEME DER VERWENDUNG VON ETHANOL ALS KRAFTSTOFF FÜR NUTZFAHRZEUGE)**

THE CHARACTERISTICS OF ETHANOL ARE COMPARED TO THOSE OF GASOLINE AND DIESEL FUEL, AND SOLUTIONS FOR CONVERTING COMMERCIAL VEHICLES TO ETHANOL OPERATION ARE DISCUSSED, WITH PARTICULAR REFERENCE TO BRAZIL. ONE SOLUTION IS THE ADAPTATION OF THE DIESEL ENGINE TO ENABLE IT TO OPERATE ON ETHANOL FUEL; IN THIS CONTEXT THREE ALTERNATIVES ARE CONVERSION TO INTERNAL COMBUSTION OPERATION, CHANGE TO A HIGH COMPRESSION DIESEL ENGINE, AND BI-FUEL OPERATION. THE SECOND SOLUTION, THE REVERSE OF THE FIRST, IS TO ADAPT THE SUBSTITUTE FUEL TO THE DIESEL ENGINE. IN ORDER TO MAKE ETHANOL SUITABLE FOR USE IN DIESEL ENGINES, ITS IGNITION QUALITY MUST BE CONSIDERABLY INCREASED. FUEL ADMIXTURES WHICH IMPROVE THE IGNITION QUALITY OF POOR DIESEL FUELS BY MEANS OF THEIR MORE OR LESS PRONOUNCED EXPLOSIVENESS INCLUDE AMYL NITRATE AND CYCLOHEXANOL NITRATE. OTHER FUELS OF VEGETABLE ORIGIN SUCH AS SOYBEAN OIL, BABASSU NUT OIL, COTTON SEED OIL, AND CASTOR OIL MORE CLOSELY RESEMBLE DIESEL FUEL THAN ETHANOL.

by WOLFGANG BANDEL  
DAIMLER-BENZ A.G., STUTTGART-UNTERTURKHEIM,  
GERMANY; MERCEDES-BENZ DO BRASIL, SAO  
PAULO, BRAZIL  
1977; 25P 7REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON  
ALCOHOL FUEL TECHNOLOGY--METHANOL AND  
ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 148

**RESEARCH ON THE COMBUSTION SEQUENCE WITH METHANOL OPERATION (UNTERSUCHUNG DES VERBRENNUNGSABLAUFES BEI METHANOLBETRIEB)**

THE COMBUSTION SEQUENCE FOR GASOLINE AND FOR METHANOL OPERATION OF A SINGLE-CYLINDER INTERNAL COMBUSTION ENGINE WAS INVESTIGATED. THE EFFECT OF COMPRESSION RATIO, AIR RATIO, IGNITION POINT, AND RPM ON COMBUSTION DELAY, EFFECTIVE DURATION OF COMBUSTION, AND TOTAL DURATION OF COMBUSTION WAS STUDIED FOR THE TWO FUELS. IT WAS SHOWN THAT THE COMBUSTION DELAY AND THE EFFECTIVE DURATION OF COMBUSTION, COMPRESSION BEING EQUAL, WERE SHORTER WITH METHANOL THAN WITH GASOLINE. WHEN COMPRESSION WAS INCREASED, THE COMBUSTION DELAY FOR METHANOL FURTHER DECREASED; WHEREAS, ON THE OTHER HAND, THE EFFECTIVE DURATION OF COMBUSTION WAS SOMEWHAT PROLONGED FOR THE TYPE OF COMBUSTION CHAMBER USED. THE

MAXIMUM VALUES FOR COMBUSTION RATE WERE GREATER WITH METHANOL OPERATION AT THE COMPRESSION RATIOS OF 9:3, 12:3, AND 14:5 THAN THE VALUES FOR GASOLINE OPERATION. AT A COMPRESSION RATIO OF 9:3, THE MAXIMUM VALUES FOR COMBUSTION RATE WERE GREATER THAN AT HIGHER COMPRESSION RATIOS. THE COMBUSTION DELAY DECREASED FOR GASOLINE AND METHANOL WITH AN ADVANCED IGNITION. ON THE OTHER HAND, WHEN IGNITION WAS ADVANCED, THE EFFECTIVE DURATION WAS PROLONGED. METHANOL CONSISTENTLY HAD THE SHORTER COMBUSTION DELAY AND DURATION OF COMBUSTION FOR ALL IGNITION POINTS. AS THE RPM INCREASED, THE IGNITION DELAY IN THE CRANK ANGLE WAS PROLONGED FOR GASOLINE AND METHANOL OPERATION, AND THE RESPECTIVE EFFECTIVE COMBUSTION DURATION IN THE CRANK ANGLE REMAINED APPROXIMATELY THE SAME. THE CYCLIC PEAK PRESSURE VARIATIONS, COMPRESSION BEING EQUAL, WERE HIGHER FOR METHANOL THAN FOR GASOLINE AND INCREASED AS COMPRESSION INCREASED. THE VARIATION COEFFICIENT OF THE PEAK PRESSURES WAS ALMOST EQUAL FOR BOTH FUELS AT THE COMPRESSION RATIOS STUDIED.

by F. PISCHINGER; K. KRAMER  
RHEINISCH-WESTFALISCHE TECHNISCHE  
HOCHSCHULE, AACHEN, GERMANY  
1977; 20P 4REFS  
PRESENTED AT INTERNATIONAL SYMPOSIUM ON  
ALCOHOL FUEL TECHNOLOGY--METHANOL AND  
ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
RESEARCH SPONSORED BY THE GERMAN RES.  
SOCIETY. TEXT ALSO IN GERMAN.  
Availability: REFERENCE COPY ONLY

HS-023 149

**ON THE START AND DRIVING BEHAVIOR OF METHANOL-CONTAINING FUELS (ÜBER DAS START- UND FAHRVERHALTEN  
METHANOLHALTIGER KRAFTSTOFFE)**

A TESTING AND EVALUATION PROCEDURE WAS DEVELOPED WHICH PERMITS THE CHARACTERIZATION OF START AND DRIVING BEHAVIOR WHICH CAN BE READILY REPRODUCED AND COMPARED. IN ACCORDANCE WITH THIS METHOD TESTS WERE CONDUCTED WITH METHANOL-CONTAINING FUEL MIXTURES AND CONVENTIONAL FUELS OF VARYING VOLATILITY AND COMPOSITION IN MASS-PRODUCED VEHICLES AT HIGH AND LOW AMBIENT TEMPERATURES, IN ROAD TESTS, AND ON TEST STANDS WHICH COULD BE AIR CONDITIONED. METHANOL-CONTAINING FUELS CAUSE POORER DRIVING BEHAVIOR AT HIGH AMBIENT TEMPERATURES AND/OR WITH OPERATION ON ROADS AT HIGH ALTITUDES IN COMPARISON TO FUELS CURRENTLY PRODUCED. THE DIFFERENCES ARE NOT SO PRONOUNCED FOR COLD WEATHER; METHANOL-

HS-023 150

CONTAINING FUELS CAN EVEN, UNDER CERTAIN CIRCUMSTANCES, PROVIDE BETTER PERFORMANCE.

by BERND NIERHAUVE  
ARAL FORSCHUNG/ANWENDUNG, BOCHUM,  
GERMANY

1977; 21P 3REFS  
PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 150

#### OPERATION OF INTERNAL COMBUSTION ENGINES WITH GASOLINE/METHANOL/WATER (BETRIEB VON OTTO-MOTOREN MIT BENZIN-METHANOL/ WASSER)

THE USE OF METHANOL/WATER MIXTURES AS HIGHLY KNOCKING-RESISTANT COMPONENTS IN COMBINATION WITH CARBONS OF LOW KNOCKING RESISTANCE REQUIRES THE USE OF TWO SEPARATE FUEL SYSTEMS IN A VEHICLE. IN THIS PROCEDURE IGNITABLE FUEL/AIR MIXTURES ARE FORMED IN THE CARBURETOR WITH THE INDIVIDUAL FUELS AND ARE MIXED TOGETHER IN THE INLET PIPE. THE BI-FUEL SYSTEM PERMITS THE PRODUCTION OF ENTIRE FUEL/ AIR MIXTURES WITH VARIABLE KNOCKING RESISTANCE WHICH CAN BE ADJUSTED TO THE OCTANE NUMBER REQUIREMENT OF THE ENGINE FOR ANY POINT IN OPERATION. BI-FUEL OPERATION MAKES IT POSSIBLE TO USE HIGHLY KNOCKING RESISTANT, I.E. EXPENSIVE, FUELS ONLY IF REQUIRED. THE ADDITION OF WATER TO COMBUSTION CAUSES AN INCREASE IN THE ENGINE OCTANE NUMBER VALUES OF THE FUEL/ AIR MIXTURE AND REDUCES THE EMISSION VALUES FOR NITRIC OXIDES. TEST RESULTS FROM TEST STAND AND DRIVING TESTS WITH A VOLKSWAGEN VEHICLE ARE PRESENTED. FOR VEHICLES WITH ELECTRONIC OR MECHANICAL FUEL INJECTION, THE PROCEDURE IS JUST AS FEASIBLE AS FOR CARBURETOR OPERATION; HOWEVER, THE PRODUCTION COSTS FOR THE TOTAL SECOND FUEL INJECTION SYSTEM ARE CONSIDERABLY HIGHER. THE PROCEDURE DESCRIBED MEANS HIGHER CONSTRUCTION COSTS FOR THE VEHICLES. IT REQUIRES, HOWEVER, VERY SMALL INVESTMENTS IN THE DISTRIBUTION NETWORK. ITS GREATEST ADVANTAGES ARE THE ECONOMICAL USE OF THE FUELS, THE ELIMINATION OF THE LEAD ALKYL ADDITIVE IN THE FUEL, AND ITS EFFECT OF DECREASING HARMFUL EMISSIONS IN THE EXHAUST GASES OF THE VEHICLE.

by K. STARKE  
BASF AG, TEW/TECHNISCHER PRUFSTAND,  
LUDWIGSHAFEN/RHEIN, FEDERAL REPUBLIC OF  
GERMANY  
1977; 19P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HSL 78-11

HS-023 151

#### DIRECT PRODUCTION OF ETHANOL FROM SUGAR CANE (DIREKTE HERSTELLUNG VON ATHANOL AUS ZUCKERROHR)

A NEW PROCEDURE IS PRESENTED FOR THE PRODUCTION OF ETHANOL AS AN ENGINE FUEL ADDITIVE OR SUBSTITUTE FROM PLANTS CONTAINING SUGAR OR STARCH. THE NEW PROCEDURE IS BASED UPON VAPORIZATION AT 110° C OF THE VEGETABLE MATERIAL WHICH HAS BEEN PULVERIZED IN A HAMMER MILL. AFTER THE MATERIAL IS EXTRACTED, THE SUGAR-CONTAINING SYRUP IS PROCESSED IN THE USUAL MANNER. UNDER-RIPE, OVER-RIPE, FROST DAMAGED, AND INFERIOR-GRADE SUGAR CANE, MILLET, ETC. CAN BE PROCESSED. THE FACILITIES CAN OPERATE INDEPENDENTLY OF EXISTING SUGAR FACTORIES. IN 1978 A PILOT FACILITY WITH A PRODUCTION OF 3000 LITERS PER DAY WILL BE BUILT IN A LATIN AMERICAN COUNTRY. A SECOND, EVEN SIMPLER, PROCEDURE IN WHICH THE PULVERIZED MATERIAL IS FERMENTED WITHOUT THE PRODUCTION OF SYRUP WILL ALSO BE EXAMINED.

by K. RUDOLPH; ROLF P. OWSIANOWSKI; WOLFGANG TENTSCHER  
DEUTSCHE GESELLSCHAFT FUR TECHNISCHE ZUSAMMENARBEIT (GTZ), DAG-HAMMERSKJOLD WEG 1, 6236 ESCHBORN 1, GERMANY; TECHNISCHE UNIVERSITAT, BERLIN, IPAT, GERMANY  
1977; 9P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 152

#### METHANOL SYNTHESIS AND POSSIBLE PRODUCTION OF METHYL FUEL (METHANOLSYNTHESE UND MOGLICHKEITEN DER FUEL-METHYL-HERSTELLUNG)

THE CHARACTERISTICS OF THE LURGI LOW-PRESSURE METHANOL PROCEDURE ARE SHOWN. METHANOL SYNTHESIS CAN BE LINKED WITH THE FACILITIES FOR THE PRODUCTION OF METHANOL SYNTHESIS GAS FROM GASEOUS, LIQUID, AND SOLID FUELS. THE ECONOMIC ASPECTS OF THE INDIVIDUAL PROCEDURE VARIATIONS ARE DISCUSSED IN PARTICULAR DETAIL. IT IS CONCLUDED THAT A METHANOL CONTAINING 10%-20% HIGHER ALCOHOLS CAN BE MANUFACTURED ECONOMICALLY. THE POSSIBILITIES ARE OUTLINED FOR THE PRODUCTION OF "FUEL METHANOL" (A MIXTURE OF METHANOL AND HIGHER ALCOHOLS). A PROCEDURE IS BEING DEVELOPED FOR THE CONVERSION OF METHANOL TO HIGH OCTANE GASOLINE, THE MOBIL PROCESS. AT A LOSS OF APPROXIMATELY 15% IN THERMAL EFFICIENCY, THIS METHOD IS CAPABLE OF PRODUCING GASOLINE BY TESTED PROCESSES USED IN PRODUCING METHANOL FROM HYDROCARBONS. WHEN USED ON AN INDUSTRIAL SCALE, THIS PROCESS WILL BE

ABLE TO COMPETE WITH THE FISCHER-TROPSCH PROCESS.

by G. BARON; F. W. MOLLER; E. SUPP  
LURGI KOHLE UND MINERALOLTECHNIK GMBH,  
FRANKFURT (MAIN), GERMANY

1977; 18P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY-METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 153

### THE PRODUCTION OF ENGINE FUELS BY COAL GASIFICATION (DIE HERSTELLUNG VON MOTORENKRAFTSTOFFEN DURCH KOHLEVERGASUNG)

CONVERSION OF COAL TO ENGINE FUEL CAN BE ACHIEVED BY GASIFICATION OR HYDROGENATION. GASIFICATION BY STEAM APPEARS TO BE THE METHOD OF CHOICE. THE PRODUCT OUTPUT OF THIS PROCESS DEPENDS ON PRESSURE AND TEMPERATURE, AS WELL AS THE DIFFUSION OF THE REACTING ELEMENTS AND THE CHEMICAL REACTION OF THE GASIFICATION AGENT WITH THE CARBON (COAL). THE LURGI PROCESS IS CHARACTERIZED BY A PRESSURE-DRIVEN SOLID-BED GENERATOR INTO WHICH THE COAL AND GASIFICATION AGENT ARE INTRODUCED IN COUNTERFLOW. THE WINKLER PROCESS IS GASIFICATION IN A VORTEX BED, SERVING PRIMARILY AS A STEP IN AMMONIA PRODUCTION. THE KOPPERS-TOTZEK PROCESS CONSISTS OF COAL GASIFICATION IN A FINE DUST CLOUD AT VERY HIGH TEMPERATURES. THE LURGI PROCESS IS THE ONLY ONE OPERATING AT HIGH PRESSURE, UP TO 20 BAR. NEW DEVELOPMENTS INCLUDE PERFECTION OF THE DUST AND VORTEX LAYER PROCEDURES FOR OPERATION AT HIGHER PRESSURE, USE OF HEAT FROM NUCLEAR REACTORS, PRODUCTION OF SUBSTITUTE NATURAL GAS (SNG), AND USE OF COMBINATIONS OF PROCESSES FOR ENVIRONMENTALLY SAFE POWER PRODUCTION. A COMPARISON OF COSTS SHOWS THAT THE FISCHER-TROPSCH SYNTHESIS IS THE MOST EXPENSIVE METHOD AND THAT NUCLEAR STEAM GASIFICATION COMBINED WITH METHANOL SYNTHESIS IS THE ONLY ECONOMICALLY FEASIBLE WAY TO USE COAL GASIFICATION.

by KARL H. VAN HEEK; H. JUNGTGEN  
BERGBAU-FORSCHUNG GMBH, ESSEN, WEST GERMANY

1977; 19P 15REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY-METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 154

### PRODUCTION OF METHANOL FROM RHINE LIGNITE (HERSTELLUNG VON METHANOL AUS RHEINISCHER BRAUNKOHLE)

WINKLER'S VORTEX BED PROCESS IS PARTICULARLY SUITABLE FOR THE GASIFICATION OF COAL FOR METHANOL PRODUCTION. A REFINEMENT OF THE CONVENTIONAL WINKLER PROCESS AT HIGHER TEMPERATURES AND PRESSURES, THE WINKLER HIGH TEMPERATURE (WHT) PROCEDURE, IS EXPLAINED AND ITS CURRENT DEVELOPMENT IS SUMMARIZED. A PROCEDURAL DESIGN IS PRESENTED FOR A LARGE FACILITY FOR THE PRODUCTION OF METHANOL FROM RHINE LIGNITE BY THE WHT PROCESS, AND THE SPECIFIC PROBLEMS OF PROCESSING COAL AS A RAW MATERIAL ARE DISCUSSED. AMONG THE COSTS OF PRODUCING METHANOL ARE THOSE FOR RAW MATERIAL, AUXILIARY AND OPERATIONAL MATERIALS, ENERGY, INVESTMENT COSTS FOR PROCESS AND SUBSYSTEMS (COMPONENTS AND CONSTRUCTION), AND OPERATIONAL COSTS (PERSONNEL, REPAIRS, INSURANCE). METHANOL FROM LIGNITE CAN BE PRODUCED BY THE WHT METHOD AT A PRICE COMPETITIVE WITH METHANOL FROM MATERIALS USED TODAY. THIS METHOD IS OF INTEREST TO OTHER COUNTRIES WITH SUBSTANTIAL COAL SUPPLIES (U.S., CANADA, SOVIET UNION, AND AUSTRALIA), AND OF PARTICULAR INTEREST TO COUNTRIES WITH EXCESSIVE COAL SUPPLIES AND THE NEED TO IMPORT PETROLEUM (BRAZIL, AUSTRALIA, AND SOUTH AFRICA).

by F. FRANKE; E. PATTAS; E. NITSCHKE; J. KELLER  
RHEINISCHE BRAUNKOHLENWERKE AG, COLOGNE, GERMANY; UHDE GMBH, DORTMUND, GERMANY

1977; 25P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY-METHANOL AND ETHANOL, WOLFSBURG, GERMANY 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 155

### PROCEDURES AND PRODUCTION COSTS FOR THE PREPARATION OF METHANOL AS A CARBURETOR FUEL IN THE FRG [FEDERAL REPUBLIC OF GERMANY] - SURVEY OF POSSIBLE RAW MATERIALS AND SITES OF FACILITIES (VERFAHRENSWEGE UND GESTEHKOSTEN FÜR DIE BEREITSTELLUNG VON METHANOL ALS VERGASERKRAFTSTOFF IN DER BRD - EINE BETRACHTUNG ÜBER MOGLICHE ROHSTOFFE UND STANDORTE VON ANLAGEN)

PARADOXICALLY, THE BEST MATERIALS FOR PRODUCING METHANOL ARE GASOLINE AND NATURAL GAS. LACKING THESE, COAL AND PARTICULARLY LIGNITE ARE LOGICAL ALTERNATIVES, THE LATTER BEING PRODUCED BY OPEN PIT MINING. WOOD IS A POSSIBLE SOURCE OF METHANOL FOR COUNTRIES SUCH AS CANADA AND BRAZIL. NUCLEAR POWER AS A SOURCE OF ENERGY IS TO BE CONSIDERED. TRASH IS A MATERIAL HAVING

COMBUSTION POTENTIAL AND CARBON CONTENT. A TABULATED OVERVIEW IS PRESENTED OF THE PROCEDURAL STEPS INVOLVED IN METHANOL PRODUCTION, WITH ESTIMATES OF CAPITAL INVESTMENT INVOLVED. EACH PROCESS HAS ITS OWN SITE REQUIREMENT, DETERMINED BY THE RAW MATERIAL AND ALLIED TRANSPORTATION COSTS. THE RESULTING COSTS SHOW A CONSIDERABLE INCREASE OVER CURRENT MARKET PRICES FOR METHANOL. PROSPECTS OF NEW PROCEDURES ARE OUTLINED, WHICH ARE EXPECTED TO REQUIRE LONG AMORTIZATION TIMES AND FAVORABLE FINANCING CONDITIONS. PROBLEMS CONNECTED WITH MARKETING AN ALTERNATIVE FUEL (M15) ARE BRIEFLY DISCUSSED. THE EXEMPTION OF METHANOL COMPONENTS FROM THE PETROLEUM TAX WOULD BE ONE WAY TO OFFER M15 AT COMPETITIVE PRICES IN SPITE OF HIGH METHANOL COSTS.

by K.-J. MUNDO  
UHDE GMBH, DORTMUND, GERMANY  
1977; 19P 5REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

#### POSSIBLE ECONOMIC USES OF ALCOHOL FUELS IN VEHICLES WITH INTERNAL COMBUSTION ENGINES (MOGLICHKEITEN ZUM WIRTSCHAFTLICHEN EINSATZ VON ALKOHOLKRAFTSTOFFEN IN KRAFTFAHRZEUGEN MIT OTTOMOTOREN)

AN OVERVIEW IS PRESENTED OF THE MOST INTERESTING ENGINE DESIGNS FOR USE OF ALCOHOL FUELS SUCH AS METHANOL, ETHANOL, AND ALCOHOL/GASOLINE FUEL MIXTURES IN INTERNAL COMBUSTION ENGINES. PARTICULAR EMPHASIS IS PLACED ON FUEL CONVERSION, ECONOMIC FEASIBILITY, AND MARKET INTRODUCTION STRATEGY. ALCOHOLS ARE TO BE PREFERRED AS SUBSTITUTE FUELS FOR THE SHORT AND INTERMEDIATE TERM. THEY CAN BE USED ALONE OR IN FUEL MIXTURES WITH GASOLINE. BI-FUEL ALCOHOL-DIESEL OPERATION IS FEASIBLE IN DIESEL ENGINES. THE METHANOL ENGINE HAS SUPERIOR EFFICIENCY DUE TO GREATER VAPORIZATION HEAT, AND POSSIBLY DUE TO METHANOL'S PRELIMINARY DECOMPOSITION REACTIONS. ECONOMIC FEASIBILITY OF ALTERNATIVE FUELS IS EVALUATED BY THREE CRITERIA: COST OF FUEL AT THE PUMP, FUEL CONSUMPTION PER VEHICLE, AND ECONOMIC COSTS FOR CONVERSION OF THE VEHICLES AND THE DISTRIBUTION SYSTEM. METHANOL IS ONE OF THE MOST REASONABLE ALTERNATIVE FUELS BASED ON COAL. ETHANOL FROM BIOMASS (SUGAR CANE, MANIOC, ETC.) WILL BE MARKETABLE IN A FEW YEARS. COSTS AT THE PUMP FOR METHANOL AND SYNTHETIC FUELS ARE APPROXIMATELY EQUAL, WITH ETHANOL DOUBLE THE PRICE. LIQUID FUELS ARE SUPERIOR TO GASES DUE TO LOSS-FREE STORAGE AND A FAVORABLE LOAD/TOTAL WEIGHT

RATIO. METHANOL AND ETHANOL ARE CONSIDERABLY LOWER IN CALORIFIC VALUE THAN GASOLINE, BUT HAVE SUPERIOR ENERGY CONSUMPTION. METHANOL WOULD BE MARKETABLE IF ITS SELLING PRICE WERE LESS THAN 53% OF SUPER GASOLINE PRICE; ETHANOL WOULD HAVE TO BE PRICED LESS THAN 75% OF THAT PRICE. ALCOHOLS INCREASE KNOCKING RESISTANCE WHEN ADDED TO GASOLINE, AND CHANGE THE BOILING CHARACTERISTICS AND BEHAVIOR OF THE FUEL IN THE ENGINE. IN SOME CASES, THE COMPOSITION OF THE BASE GASOLINE MUST BE CHANGED. TAXES WERE NOT CONSIDERED IN THE ABOVE COST CALCULATIONS. SUBSTITUTION OF A FEW SYNTHETIC PARTS IS NECESSARY FOR CONVERTING ENGINES FROM GASOLINE TO GASOLINE/ ALCOHOL OPERATION. FOR PURE ALCOHOL OPERATION, CORROSION OF ZINC INJECTED DIE CASTINGS AND LIGHT METAL MATERIALS MUST BE OVERCOME. A LARGER FUEL TANK WILL BE NECESSARY. A COLD-START APPARATUS WILL BE NEEDED UNLESS SMALL AMOUNTS OF PETROLEUM ETHER, DIMETHYL ETHER, OR ISOPENTANE CAN BE ADDED TO THE ALCOHOL WITHOUT OTHER OPERATIONAL PROBLEMS. ENGINE ADAPTATION TO ALCOHOL INCLUDES INCREASED COMPRESSION RATIO. A VOLKSWAGEN PROTOTYPE ENGINE IS EQUIPPED WITH A SYSTEM TO PREHEAT THE FUEL MIXTURE BY HOT EXHAUST GASES ("EARLY FUEL EVAPORATION" OR "HOT SPOT").

by WINFRIED BERNHARDT; AXEL KONIG; HOLGER MENRAD; WENPO LEE  
VOLKSWAGENWERK AG, FORSCHUNG  
ENERGIETECHNIK UND NEUE TECHNOLOGIEN,  
WOLFSBURG, WEST GERMANY  
1977; 24P 16REFS

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

#### OBJECTIVES AND MAIN FOCI OF RESEARCH ON ALCOHOL FUELS IN THE FEDERAL REPUBLIC OF GERMANY (ZIELSETZUNGEN UND SCHWERPUNKTE DER FORSCHUNGSAKTIVITÄTEN FÜR ALKOHOLISCHE KRAFTSTOFFE IN DER BUNDESREPUBLIK DEUTSCHLAND)

CRITERIA FOR EVALUATING ALTERNATIVE FUELS INCLUDE LONG TERM ECONOMIC FEASIBILITY AND AVAILABILITY, SAFE CONTROL, NO TOXICITY, LOWER ENVIRONMENTAL POLLUTION THAN PRESENT FUELS, CAPABILITY OF MANUFACTURE FROM RAW MATERIALS, AND INTERNATIONAL USEFULNESS. RESEARCH PROJECTS BEING CARRIED ON BY VOLKSWAGEN AND OTHER COMPANIES CONCERN COST EFFECTIVENESS AND MARKETING STRATEGY, FLEET TESTING OF A GASOLINE/METHANOL MIXTURE, M15, DEVELOPMENT OF A PURE METHANOL PROTOTYPE ENGINE, AND GASOLINE/METHANOL MIXING OPERATION FOR INTERNAL COMBUSTION ENGINES. FUTURE

RESEARCH IS OUTLINED IN OPTIMIZATION OF METHANOL AND ETHANOL COMBUSTION FUELS. UNDER THIS PROGRAM, MODEL FUELS WILL BE PRODUCED AND EVALUATED BY ENGINE TESTS FOR PERFORMANCE, CONSUMPTION, AND EXHAUST GAS BEHAVIOR. BI-FUEL OPERATION IS BEING RESEARCHED, INCLUDING SUCH FACTORS AS FUEL STORAGE IN THE VEHICLE, OPTIMIZATION OF MIXING DEVICES, REGULATION, AND MARKETING AND DISTRIBUTION MEASURES. FURTHER RESEARCH IS CONCERNED WITH OPTIMIZING THE PURE ALCOHOL ENGINE IN PERFORMANCE, CONSUMPTION, EXHAUST GAS BEHAVIOR, AND FUEL USE. COMPARING ENERGY LOSSES IN PRODUCTION OF FUELS FROM PRIMARY ENERGY SOURCES TO THOSE OF PETROLEUM PRODUCTS LEADS TO THE CONCLUSION THAT ALL CURRENT PROCEDURES EXCEPT PRODUCTION OF ETHANOL FROM BIOMASS BY ALCOHOL FERMENTATION INVOLVE CONSIDERABLE ENERGY LOSSES.

by EBERHARD PLASSMAN  
TECHNISCHER UBERWACHUNGS-VEREIN,  
RHINELAND, COLOGNE, GERMANY

1977; 23P 14REFS  
PRESENTED AT INTERNATIONAL SYMPOSIUM ON  
ALCOHOL FUEL TECHNOLOGY--METHANOL AND  
ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977.  
TEXT ALSO IN GERMAN.

Availability: REFERENCE COPY ONLY

HS-023 158

#### **GETTING SERIOUS ABOUT EV [ELECTRIC VEHICLE] MOTORS**

COMPARED WITH CONVENTIONAL INTERNAL-COMBUSTION POWERED VEHICLES, ELECTRIC VEHICLES (EV'S) HAVE FAVORABLE OPERATING EXPENSES, LOW MAINTENANCE, AND NO GASEOUS EMISSIONS OR NOISE. SUCCESSFUL EV APPLICATIONS INCLUDE LIFT TRUCKS AND GOLF CARTS. METHODS ARE PRESENTED FOR CALCULATING THE MOTOR/ BATTERY COMBINATIONS NECESSARY TO PROVIDE GOOD ROAD VEHICLE CHARACTERISTICS IN EV'S. SPECIFIC ATTENTION IS GIVEN TO PRELIMINARY FORCE, POWER, AND TORQUE CALCULATIONS AS A BASIS FOR OPTIMIZATION. IN ORDER TO ACHIEVE PREDETERMINED PERFORMANCE REQUIREMENTS, THE NECESSARY TRACTION FORCE NEEDED IS CALCULATED BY CONSIDERING THE FORCES ACTING ON THE MOTOR: TIRE ROLLING FRICTION AND AIR DRAG. HILL CLIMBING ABILITY AND ACCELERATION REQUIRE ADDITIONAL POWER. THE EFFECTIVE TORQUE/SPEED CHARACTERISTICS OF AN EV MOTOR DEPEND ON TIRE SIZE AND DIFFERENTIAL GEAR RATIO. THE MOTOR MUST BE SELECTED TO PROVIDE CONTINUOUS TORQUE AND SPEED TO CONFORM TO THESE CONSTRAINTS. THE MOST RELIABLE AND PRACTICAL ENERGY SOURCE FOR EV APPLICATION IS THE LEAD/ACID BATTERY, WHICH HAS THE DRAWBACKS OF WEIGHT, COST, AND LIMITED ENERGY DENSITY. THREE FACTORS INVOLVED IN BATTERY SELECTION ARE SYSTEM VOLTAGE (SHOULD BE THE MAXIMUM VOLTAGE FOR REQUIRED ENERGY WITHOUT INCREASING COST); ENERGY CAPACITY (RANGE DEPENDS ON TERRAIN COVERED); AND WEIGHT. (FOR 120 LB OF TRACTIVE FORCE AND A 100-MILE RANGE, THE REQUIRED BAT-

TERY WEIGHS 2000 LB.) ACCELERATION DRAWS CURRENT FASTER THAN LEVEL CRUISING, REDUCING THE EXPECTED RANGE.

by PETER WALKER  
Publ: MACHINE DESIGN V50 N10 P108-12 (11 MAY 1978)  
1978  
Availability: SEE PUBLICATION

HS-023 159

#### **FLEXURAL EFFECTS IN DISC BRAKE PADS**

DETAILS OF THE AUTOMOBILE DISC BRAKE ARE OUTLINED, LEADING TO THE FLEXURAL REQUIREMENTS AND CONSTRUCTION OF FRICTION PAD ASSEMBLIES. A THEORETICAL TREATMENT OF THESE IS GIVEN, INTRODUCING THE CONCEPT OF A CRITICAL LENGTH WHICH INFLUENCES PRESSURE DISTRIBUTION AND RELIABILITY. A SIMPLE EXPERIMENT ILLUSTRATES THE CRITICAL LENGTH EFFECT; DETAILS OF THE EXPERIMENTAL AND THEORETICAL CORRELATION ARE GIVEN. THE FINITE ELEMENT TECHNIQUE IS APPLIED IN A COMPUTER STUDY OF THE STRUCTURAL BEHAVIOR OF PAD ASSEMBLIES WHEN SUBJECTED TO VARIOUS LOADS. IT WAS FOUND THAT HIGH ASPECT RATIO PADS MAY TEND TO SEPARATE AT THE PAD/BACKPLATE INTERFACE AND WILL NOT DISTRIBUTE PRESSURE INITIALLY BEYOND THE CRITICAL LENGTH. CRITICAL LENGTH IS DEPENDENT ON THE COMPRESSION MODULUS OF THE PAD MATERIAL RELATIVE TO THE FLEXURAL STIFFNESS AND LOADING OF THE BACKPLATE. HIGH FLEXURAL STIFFNESS OF THE BACKPLATE IS REQUIRED TO DISTRIBUTE LOAD TO THE PAD. LOW PAD COMPRESSION IS DESIRABLE FOR IMPROVING PRESSURE DISTRIBUTION. THE EFFECT OF PAD COMPRESSIBILITY ON BRAKE PEDAL TRAVEL IS SIGNIFICANT ONLY AT LOW COMPRESSION MODULUS VALUES.

by P. R. J. HARDING; B. J. WINTLE  
Publ: PROCEEDINGS OF INSTITUTION OF  
MECHANICAL ENGINEERS V192 P1-7 (MAR 1978)  
1978; 2REFS  
PREPARED FOR PRESENTATION AT ORDINARY  
MEETING OF AUTOMOBILE DIV., BIRMINGHAM,  
ENGLAND, 5 JAN 1978.  
Availability: SEE PUBLICATION

HS-023 160

#### **AN INVESTIGATION OF THE SOURCES OF BLOWBY IN SINGLE-CYLINDER SUPERCHARGED DIESEL ENGINES**

MEASUREMENTS OF CARBON DIOXIDE CONCENTRATIONS IN THE EXHAUST AND IN THE CRANKCASE OF TWO DIFFERENT TYPES OF SINGLE-CYLINDER, SUPERCHARGED DIESEL ENGINES HAVE BEEN USED TO DETERMINE THE AMOUNT OF EXHAUST GAS REACHING THE CRANKCASE AS PISTON RING BLOWBY AND AS LEAKAGE THROUGH THE EXHAUST VALVE STEM-TO-GUIDE CLEARANCE. OVER A WIDE RANGE OF OPERATING CONDITIONS IN BOTH ENGINES THE CARBON DIOXIDE CONCENTRATION WAS FOUND TO BE MORE DEPENDENT ON ENGINE

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FUELING RATE PER HOUR THAN ON FUEL INPUT PER STROKE. IT WAS ESTABLISHED THAT BLOWBY THROUGH THE EXHAUST VALVE GUIDE WAS A MAJOR CONTRIBUTOR TO CRANKCASE CONTAMINATION. A SIMPLE METHOD HAS BEEN DEVISED, REQUIRING ONLY MINOR MODIFICATIONS TO THE ENGINE, THAT PERMITS THE BLOWBY THROUGH THE PISTON RING PACK AND THE EXHAUST VALVE GUIDES TO BE DETERMINED SEPARATELY IN TURBOCHARGED PRODUCTION ENGINES. BY COMPARING THE RELATIVE CONCENTRATION OF CARBON DIOXIDE (INERT) AND OF NITROGEN OXIDES (REACTIVE) IN THE EXHAUST GAS AND THE BLOWBY, IT SHOULD BE POSSIBLE TO ESTIMATE THE DEGREE TO WHICH SUCH GASES REACT WITH THE LUBRICANT IN THE VARIOUS AREAS OF THE ENGINE. A MATHEMATICAL MODEL OF THE BLOWBY PROCESS IS PRESENTED, ILLUSTRATING THE SOURCES OF BLOWBY GASES.

by B. BULL; M. A. VOISEY

Publ: PROCEEDINGS OF INSTITUTION OF MECHANICAL ENGINEERS V192 P39-48 (MAR 1978)  
1978; 2REFS  
PREPARED FOR PRESENTATION AT ORDINARY MEETING OF INSTITUTION OF MECHANICAL ENGINEERS, LONDON, 8 FEB 1978.  
Availability: SEE PUBLICATION

HS-023 161

#### THE USE OF ALUMINIUM FOR COMMERCIAL VEHICLE STRUCTURES--A FEASIBILITY STUDY

THE USE OF ALUMINUM ALLOY INSTEAD OF STEEL FOR THE STRUCTURAL COMPONENTS OF A 32 TON ARTICULATED LORRY HAS BEEN EXAMINED. AMONG THE TOPICS DISCUSSED ARE BASIC PROPERTIES, TECHNOLOGY, AND FORMABILITY OF ALUMINUM ALLOYS, AND STRUCTURAL TECHNIQUES. THE PROBABLE MANUFACTURING DIFFICULTIES HAVE BEEN ASSESSED AND SHOWN TO BE MINIMAL. THE SAVINGS IN WEIGHT POSSIBLE BY USING ALUMINUM HAVE BEEN CALCULATED FROM A STRUCTURAL ANALYSIS OF THE CAB, TRACTOR CHASSIS, AND TRAILER; FROM THIS AND AN ASSESSMENT OF THE MANUFACTURING PROCESSES THE EXTRA COST OF MANUFACTURING IN ALUMINUM HAS BEEN DETERMINED. A TYPICAL CASE STUDY SHOWS THAT THIS EXTRA COST CAN BE EASILY RECOVERED BY UTILIZING THE INCREASED LOAD CAPACITY OF THE VEHICLE DURING THE FIRST FEW YEARS OF ITS LIFE.

by B. B. HUNDY; S. BROADSTOCK

Publ: PROCEEDINGS OF INSTITUTION OF MECHANICAL ENGINEERS V192 P81-92 (MAR 1978)  
1978; 7REFS  
PREPARED FOR PRESENTATION AT ORDINARY MEETING OF AUTOMOBILE DIV., LONDON, 14 FEB 1978.  
Availability: SEE PUBLICATION

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HS-023 162

#### BICYCLE ACCIDENT FACTS

ACCIDENT COUNTERMEASURE PROGRAMS TO PREVENT BICYCLE ACCIDENTS ARE BEING ESTABLISHED TO AUGMENT SAFETY RULES AND DESIGNATION OF SEPARATE BIKEWAYS. PURPOSES OF THESE PROGRAMS INCLUDE DEVELOPMENT OF RIDING SKILLS, MOTORIST AND BICYCLIST EDUCATION, AND FACILITY/ROADWAY MODIFICATIONS. ADULT USE OF BICYCLES HAS BEEN INCREASING, ESPECIALLY IN DOWNTOWN AREAS AND OTHER PLACES WHERE BICYCLES WERE SELDOM SEEN. THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) HAS INITIATED A THREE PHASE BICYCLE ACCIDENT RESEARCH EFFORT: A RESEARCH STUDY TO IDENTIFY BASIC BICYCLE ACCIDENT TYPES, CAUSAL FACTORS, AND TARGET POPULATIONS; DEVELOPMENT OF GENERAL COUNTERMEASURES INVOLVING EDUCATION, TRAINING SKILLS, AND MODEL REGULATIONS; AND REFinement OF THE RECOMMENDED APPROACHES AND EXPERIMENTATION. FOLLOWING COMPLETION OF THIS PROGRAM, SPECIFIC TRAFFIC SAFETY PROGRAMS WILL BE DEVELOPED AND TESTED IN SAMPLE COMMUNITIES. DR. KENNETH CROSS' FOUR-YEAR STUDY OF 166 FATAL AND 753 NONFATAL BICYCLE/MOTOR VEHICLE ACCIDENTS IS DESCRIBED. THIS TYPE OF ACCIDENT ACCOUNTS FOR ONLY 1% OF ALL BICYCLE ACCIDENTS, BUT 82% OF ALL SERIOUS-INJURY AND FATAL ACCIDENTS. THE CROSS STUDY IDENTIFIED AND CLASSIFIED 37 MUTUALLY EXCLUSIVE BICYCLE/MOTOR VEHICLE ACCIDENT TYPES UNDER SEVEN GENERAL CLASSES. THE COUNTERMEASURES SUGGESTED BY THE DATA FROM THIS STUDY INCLUDE IMPROVED BICYCLE EDUCATION AND ENFORCEMENT PROGRAMS, REQUIRING GREATER SIGHT DISTANCES AT INTERSECTIONS, AND REQUIRING CLOTHING OR EQUIPMENT TO INCREASE BICYCLIST VISIBILITY. WRONG-WAY RIDING IS A MAJOR FACTOR IN 30% OF ALL ACCIDENTS INVOLVING BICYCLES AND MOTOR VEHICLES. OVERTAKING ACCIDENTS OCCUR PRINCIPALLY AT NIGHT, POINTING OUT THE NEED FOR BETTER REGULATION OF BICYCLE LIGHTS. NO COMPARISON DATA ARE AVAILABLE OF ACCIDENTS ON ROADS WITH AND WITHOUT BIKEWAYS, BUT COUNTERMEASURES SUGGESTED BY THE CROSS STUDY COULD BE USED TO SAVE LIVES BEFORE NHTSA REGULATIONS TAKE EFFECT.

by DAN BURDEN

Publ: BICYCLE FORUM N1 P12-6 (SPRING 1978)  
1978; 1REF  
Availability: SEE PUBLICATION

HS-023 163

#### 402 FUNDING FOR BICYCLE SAFETY [FEDERAL HIGHWAY SAFETY PROGRAM]

HIGHWAY SAFETY PROGRAM (402) FUNDS ARE INCREASINGLY BEING USED FOR BICYCLE SAFETY PROGRAMS, AND ARE PROVING APPLICABLE TO A WIDE VARIETY OF PROGRAM TYPES, HELPING TO MAKE A COMPREHENSIVE APPROACH TO BICYCLE SAFETY EDUCATION AND TO ENABLE STATE AND

November 30, 1978

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LOCAL AGENCIES TO AFFORD BETTER ENFORCEMENT. THE FUNDING CHAIN OF THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION'S 402 PROGRAM FUNDS IS DESCRIBED. THE GOVERNOR'S REPRESENTATIVE MAKES THE STATE'S FUNDING DECISIONS, DEVELOPING AN ANNUAL WORK PLAN FOR SPENDING 402 FUNDS AND STATE MATCHING FUNDS. THIS PLAN AND THE EXPENDITURES ARE MONITORED BY THE REGIONAL OFFICE OF HWY. SAFETY. SOME TYPES OF BICYCLE PROGRAM ACTIVITIES FUNDED WITH 402 MONEY INCLUDE BICYCLE SAFETY EDUCATION PROGRAMS, BIKE RODEOS, ENFORCEMENT PROGRAMS, ACCIDENT ANALYSES, PUBLIC INFORMATION CAMPAIGNS, BICYCLE CURRICULA OR FILMS, DRIVER'S MANUAL MODIFICATIONS TO INCLUDE BICYCLE INFORMATION, JUVENILE BICYCLE PEER COURTS, BICYCLE ADVISORY COMMITTEES, BICYCLE SAFETY WORKSHOPS, AND CREATION OF A BICYCLE COORDINATOR'S POSITION. RECENT CHANGES IN 402 FUNDING REQUIREMENTS ARE OUTLINED, AND A BILL BEFORE CONGRESS ALTERING THE PROPORTION OF MATCHING FUNDS IS DESCRIBED. PROCEDURES FOR OBTAINING 402 FUNDS ARE DISCUSSED AND STATE ALLOCATIONS FOR 1978 ARE TABULATED.

by COLETTE O'LEARY

Publ: BICYCLE FORUM N1 P17-9 (SPRING 1978)  
1978

Availability: SEE PUBLICATION

HS-023 164

#### FEDERAL BICYCLE PROGRAMS AND PROJECTS

FEDERAL BICYCLE PROGRAMS AND PROJECTS ARE LISTED BY AGENCY, TITLE, OBJECTIVES AND ELEMENTS, FINAL PRODUCT, AND STATUS. THE CONTRACTOR IS IDENTIFIED, IF APPLICABLE. MOST OF THE PROGRAMS ARE SPONSORED BY DEPT. OF TRANSPORTATION; OTHER SPONSORS INCLUDE THE CONSUMER PRODUCT SAFETY COMMISSION, DEPT. OF AGRICULTURE, SMITHSONIAN INSTITUTION, DEPT. OF INTERIOR, DEPT. OF ENERGY, GENERAL SERVICES ADMINISTRATION, AND ENVIRONMENTAL PROTECTION AGENCY. AMONG THE TOPICS COVERED ARE URBAN BIKEWAYS, LOW-COST BICYCLE PATH PAVEMENTS, BICYCLE-SAFE GRATE INLETS, EFFECTIVE TREATMENTS OF OVER-CROSSINGS AND UNDER-CROSSINGS, IDENTIFICATION AND FEASIBILITY OF DEMAND INCENTIVES FOR NONMOTORIZED TRAVEL, AND BICYCLE SAFETY PROBLEMS AND COUNTERMEASURES. ALSO CONSIDERED ARE HEALTH ASPECTS OF URBAN BICYCLING, URBAN PEDESTRIAN AND BICYCLE CONSIDERATIONS, COMMUNITY BICYCLING PROGRAMS, REGIONAL WORKSHOPS ON BICYCLE SAFETY, BICYCLE PARKING PROGRAMS, AND BICYCLE INFORMATION DOCUMENTS.

by LESLIE BALDWIN

Publ: BICYCLE FORUM N1 P30-5 (SPRING 1978)  
1978

Availability: SEE PUBLICATION

HS-023 165

#### INSPECTOR'S GUIDE FOR VEHICLE EMISSIONS CONTROL

TECHNICAL AND BACKGROUND KNOWLEDGE IS PROVIDED FOR THE AUTOMOTIVE EMISSIONS CONTROL INSPECTOR TO PERFORM A SATISFACTORY EMISSIONS INSPECTION ON AN AUTOMOBILE, LIMITED TO TAKING AN EXHAUST SAMPLE AND READING THE RESULTS ON AN EMISSIONS ANALYZER. THE BACKGROUND MATERIAL CONTAINED IS BASIC GENERAL INFORMATION AND SHOULD BE USED ONLY TO HELP THE INSPECTOR TO ACQUIRE A JOB ENTRY LEVEL OF PROFICIENCY. THESE INSTRUCTIONAL MATERIALS PROVIDE THE INSPECTOR WITH TECHNICAL INFORMATION ON EMISSIONS CONTROL SYSTEMS AND RELATED NARRATIVES ON THE NONDISPERSIVE INFRARED ANALYZER. IT SHOULD ALSO PROVIDE HIM WITH THE BASIC INFORMATION NEEDED TO UNDERSTAND THE CONCEPTS OF THE VARIOUS EMISSIONS CONTROL SYSTEMS PRESENTLY ON AUTOMOBILES. AMONG THE TOPICS COVERED ARE CAUSE AND EFFECT OF AUTOMOBILE EMISSIONS SUCH AS HYDROCARBONS, OXIDES OF NITROGEN, CARBON MONOXIDE, AND PARTICULATE MATTER. EMISSION CONTROL SYSTEMS DISCUSSED INCLUDE POSITIVE CRANKCASE VENTILATION, THERMOSTATIC AIR CLEANERS, AIR INJECTION REACTION, FUEL EVAPORATIVE CONTROL, EXHAUST GAS RECIRCULATION, SPARK CONTROL, AND CATALYTIC CONVERTER SYSTEMS.

by B. D. HAYES; M. T. MANESS; B. D. LEE; R. A. RAGAZZI  
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EPA-T900621-01-0

Rept. No. EPA-450/3-77-032; 1977; 130P

SEE ALSO HS-023 166--HS-023 168.

Availability: ENVIRONMENTAL PROTECTION AGENCY, CONTROL PROGRAMS DEVEL. DIV., RESEARCH TRIANGLE PARK, N.C. 27711

HS-023 166

#### INSTRUCTOR'S GUIDE FOR VEHICLE EMISSIONS CONTROL TRAINING

EXPLANATIONS ARE PROVIDED FOR EACH BASIC EMISSIONS CONTROL SYSTEM AND SOME OF THE MORE COMMON DEVICES FOUND ON TODAY'S CARS. THE GUIDE IS DESIGNED TO ALLOW THE INSTRUCTOR OR FACILITATOR TO LEAD A GROUP OF STUDENTS THROUGH THE KEY POINTS OF EACH EMISSIONS CONTROL SYSTEM, SUCH AS PART IDENTIFICATION, AND THE OPERATION, CONTROL, AND EFFECTS OF EACH SYSTEM ON HYDROCARBON/CARBON MONOXIDE EMISSIONS AND DRIVEABILITY. THE EMISSIONS CONTROL DEVICES DISCUSSED INCLUDE POSITIVE CRANKCASE VENTILATION, THERMOSTATIC AIR CLEANERS, AIR INJECTION SYSTEMS, FUEL EVAPORATIVE CONTROL,

HS-023 167

HSL 78-11

EXHAUST GAS RECIRCULATION, SPARK CONTROL,  
AND CATALYTIC CONVERTER SYSTEMS.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI  
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EPA-T900621-01-0

Rept. No. EPA-450/3-77-033; 1977; 103P  
SEE ALSO HS-023 165, HS-023 167, AND HS-023 168.

Availability: ENVIRONMENTAL PROTECTION AGENCY,  
CONTROL PROGRAMS DEVEL. DIV., RESEARCH  
TRIANGLE PARK, N.C. 27711

HS-023 167

**TRANSPARENCY MASTERS FOR USE WITH  
INSTRUCTOR'S GUIDE FOR VEHICLE EMISSIONS  
CONTROL**

THE TEACHING AID MASTERS ILLUSTRATE THE IN-  
FRARED EXHAUST GAS ANALYZER, IGNITION MIX-  
TURE ADJUSTMENTS AND TIMING, AND THE FOLLOWING EMISSION CONTROL SYSTEMS: POSITIVE CRANKCASE VENTILATION, THERMOSTATIC AIR CLEANERS, AIR INJECTION SYSTEMS, FUEL EVAPORATION CONTROL, EXHAUST GAS RECIRCULATION, SPARK CONTROL, AND CATALYTIC CONVERTERS.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI  
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Rept. No. EPA-450/3-77-034; 1977; 120P  
SEE ALSO HS-023 165, HS-023 166, AND HS-023 168.

Availability: ENVIRONMENTAL PROTECTION AGENCY,  
CONTROL PROGRAMS DEVEL. DIV., RESEARCH  
TRIANGLE PARK, N.C. 27711

HS-023 168

**STUDENT'S WORKBOOK FOR VEHICLE  
EMISSIONS CONTROL TRAINING**

SOME BASIC EMISSIONS CONTROL SYSTEMS ARE EX-  
PLAINED, AS WELL AS SOME OF THE MORE COM-  
MON DEVICES FOUND ON TODAY'S CARS. THESE  
SYSTEMS INCLUDE POSITIVE CRANKCASE VENTILA-  
TION, THERMOSTATIC AIR CLEANERS, AIR INjec-  
TION, FUEL EVAPORATION CONTROL, EXHAUST GAS  
RECIRCULATION, SPARK CONTROL, AND CATALYTIC  
CONVERTERS. INCLUDED IN THE EXPLANATION OF  
EACH SYSTEM ARE PART IDENTIFICATION, SYSTEM  
OPERATION AND CONTROL, AND THE SYSTEM'S EF-  
FECT ON HYDROCARBON/CARBON MONOXIDE AND  
DRIVEABILITY. ALSO EXPLAINED ARE THE IN-  
FRARED EXHAUST GAS ANALYZER, AND THE EF-  
FECT OF CARBURETOR ADJUSTMENT AND TIMING  
ON EMISSIONS.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI  
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EPA-T900621-01-0

Rept. No. EPA-450/3-77-035; 1977; 99P  
SEE ALSO HS-023 165-HS-023 167.

Availability: ENVIRONMENTAL PROTECTION AGENCY,  
CONTROL PROGRAMS DEVEL. DIV., RESEARCH  
TRIANGLE PARK, N.C. 27711

HS-023 169

**MOTOR VEHICLE EMISSIONS CONTROL. BOOK 1:  
POSITIVE CRANKCASE VENTILATION SYSTEMS.  
FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL  
MATERIAL, THIS GUIDE IS ONE OF A SERIES OF  
SEVEN DESIGNED SPECIFICALLY TO TEACH THE  
CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL  
SYSTEMS TO ASSIST THE PRACTICING OR HOME  
MECHANIC TO BETTER UNDERSTAND THE POSITIVE  
CRANKCASE VENTILATION (PCV) SYSTEMS WHICH  
ARE AN INTEGRAL PART OF AUTOMOBILES TODAY.  
THE PURPOSE OF THE PCV SYSTEM IS CONSTANTLY  
TO VENTILATE THE ENGINE CRANKCASE AND TO  
PREVENT HYDROCARBONS FROM ESCAPING TO THE  
ATMOSPHERE. IT ALSO HELPS PREVENT OIL DILU-  
TION AND SLUDGE FORMATION IN THE CRANKCASE  
BY DIRECTING BLOWBY GASES IN THE CRANKCASE  
BACK INTO THE COMBUSTION CHAMBER TO BE  
BURNED IN THE NORMAL COMBUSTION PROCESS.  
ITS MAIN COMPONENTS ARE A SEALED OIL FILLER  
CAP, A SEALED DIPSTICK CAP, AN AIR INTAKE  
HOSE, AND A PCV VALVE. INTAKE MANIFOLD  
VACUUM DRAWS BLOWBY GASES FROM THE  
CRANKCASE INTO THE MANIFOLD TO BE CON-  
SUMED IN THE COMBUSTION CHAMBER. THE PCV  
VALVE PLUNGER PREVENTS BLOWBY GAS FLOW  
DURING ENGINE OFF OR ENGINE BACKFIRE CONDI-  
TIONS. BLOWBY GAS FLOW IS REGULATED BY THE  
AMOUNT OF INTAKE MANIFOLD VACUUM ACTING  
ON THE PCV VALVE SPRING AND PLUNGER.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A.  
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BOOKS 2-7 ARE HS-023 170--HS-023 175.

Availability: NTIS

HS-023 170

**MOTOR VEHICLE EMISSIONS CONTROL. BOOK 2:  
THERMOSTATIC AIR CLEANER SYSTEMS. FINAL  
REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL  
MATERIAL, THIS GUIDE IS ONE OF A SERIES OF  
SEVEN DESIGNED SPECIFICALLY TO TEACH THE  
CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL  
SYSTEMS TO ASSIST THE PRACTICING OR HOME  
MECHANIC BETTER TO UNDERSTAND THE THERMO-  
STATIC AIR CLEANER (TAC) SYSTEMS WHICH ARE  
AN INTEGRAL PART OF AUTOMOBILES TODAY. THE  
TAC SYSTEM IS DESIGNED TO PROVIDE HEATED AIR  
TO THE CARBURETOR DURING COLD-ENGINE CON-  
DITIONS. BY PROVIDING HEATED AIR DURING ENGINE  
WARM-UP CONDITIONS, A LEANER AIR/FUEL MIX-  
TURE CAN BE USED THEREBY REDUCING  
HYDROCARBON EMISSIONS. THE SYSTEM ALSO  
ASSISTS IN COLD-ENGINE DRIVEABILITY AND THE  
ELIMINATION OF CARBURETOR ICING. THE MAIN  
COMPONENTS OF THE SYSTEM ARE AN EXHAUST  
MANIFOLD HEAT SHROUD, A HOT AIR PIPE, AN AIR  
DOOR ASSEMBLY, A VACUUM DIAPHRAGM UNIT,

AND A TEMPERATURE SENSOR. WHEN THE TEMPERATURE SENSOR DETECTS COLD ENGINE CONDITIONS, IT ALLOWS INTAKE MANIFOLD VACUUM TO REACH THE VACUUM DIAPHRAGM UNIT. WHEN THE VACUUM DIAPHRAGM RECEIVES A VACUUM SIGNAL, IT OPENS THE AIR DOOR ASSEMBLY TO ALLOW EXHAUST MANIFOLD HEATED AIR TO ENTER THE SYSTEM. AS TEMPERATURE OF INCOMING AIR REACHES APPROXIMATELY 100° F, THE TEMPERATURE SENSOR BLEEDS OFF VACUUM TO THE DIAPHRAGM UNIT CLOSING THE SYSTEM TO HEATED AIR, ALLOWING ONLY COOLER ENGINE COMPARTMENT AIR TO ENTER.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A. BARRETT

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BOOK 1 IS HS-023 169; BOOKS 3-7 ARE HS-023 171--HS-023 175.

Availability: NTIS

HS-023 171

#### **MOTOR VEHICLE EMISSIONS CONTROL. BOOK 3: AIR INJECTION REACTION SYSTEMS. FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL MATERIAL, THIS GUIDE IS ONE OF A SERIES OF SEVEN DESIGNED SPECIFICALLY TO TEACH THE CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL SYSTEMS TO ASSIST THE PRACTICING OR HOME MECHANIC BETTER TO UNDERSTAND THE AIR INJECTION REACTION (AIR) SYSTEMS WHICH ARE AN INTEGRAL PART OF AUTOMOBILES TODAY. THE PURPOSE OF THE AIR SYSTEM IS TO SUPPLY ADDITIONAL OXYGEN (AIR) AT THE EXHAUST PORTS NEAR THE EXHAUST VALVES TO EXTEND THE COMBUSTION PROCESS INTO THE EXHAUST SYSTEM. THIS REDUCES THE UNBURNED HYDROCARBON AND CARBON MONOXIDE EMISSIONS. THE MAIN COMPONENTS OF THE SYSTEM ARE THE FOLLOWING: AIR PUMP, DIVERTER VALVE, CHECK VALVE, AIR MANIFOLD, AIR NOZZLES, AND MANIFOLD VACUUM SIGNAL LINE. DURING NORMAL OPERATING CONDITIONS THE AIR PUMP SUPPLIES AIR TO THE DIVERTER VALVE WHICH THEN PASSES THE AIR ON TO THE AIR NOZZLES FOR INJECTION INTO THE EXHAUST MANIFOLD. THERE THE HOT EXHAUSTED GASES RECEIVE THE FRESH OXYGEN CHARGE AND UNDERGO FURTHER COMBUSTION. DURING DECELERATION THERE IS A HIGH INTAKE MANIFOLD VACUUM AND AN EXCESSIVELY RICH FUEL MIXTURE. IF FRESH OXYGEN WERE SUPPLIED TO THESE EXHAUST GASES, REIGNITION AND ENGINE BACKFIRE COULD RESULT. THE DIVERTED VALVE SENSES THE HIGH INTAKE MANIFOLD

VACUUM AND VENTS AIR FROM THE PUMP TO THE ATMOSPHERE.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A.

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BOOKS 1 AND 2 ARE HS-023 169 AND HS-023 170;

BOOKS 4-7 ARE HS-023 172--HS-023 175.

Availability: NTIS

HS-023 172

#### **MOTOR VEHICLE EMISSIONS CONTROL. BOOK 4: FUEL EVAPORATION CONTROL SYSTEMS. FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL MATERIAL, THIS GUIDE IS ONE OF A SERIES OF SEVEN DESIGNED SPECIFICALLY TO TEACH THE CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL SYSTEMS TO ASSIST THE PRACTICING OR HOME MECHANIC BETTER TO UNDERSTAND THE FUEL EVAPORATION CONTROL (FEC) SYSTEMS WHICH ARE AN INTEGRAL PART OF AUTOMOBILES TODAY. THE PURPOSE OF THE EVAPORATIVE EMISSIONS CONTROL SYSTEM IS TO CONTROL THE RELEASE OF HYDROCARBONS TO THE ATMOSPHERE THAT RESULTS FROM RAW FUEL VAPORS ESCAPING FROM THE FUEL TANK AND CARBURETOR VENTS. THE MAIN COMPONENTS OF THE SYSTEM ARE THE FOLLOWING: FUEL TANK, FUEL TANK FILLER CAP, VAPOR VENT LINES, VAPOR/LIQUID SEPARATOR, CHARCOAL CANISTER, AND PURGE LINE. WHEN THE FUEL TANK IS FULL AND SUBJECTED TO AN INCREASE IN TEMPERATURE, THE FUEL EXPANDS AND IS TAKEN UP IN THE BUILT-IN AIR SPACE. VAPORS ARE RELEASED; THEY PASS THROUGH THE VENT LINES TO THE VAPOR/LIQUID SEPARATOR WHICH ALLOWS THE VAPORS TO PASS THROUGH, BUT PREVENTS ANY LIQUID FUEL FROM PASSING. THE VAPORS TRAVEL TO THE ACTIVATED CHARCOAL CANISTER WHERE THEY ARE TRAPPED AND STORED. WHEN THE ENGINE IS STARTED, THE CANISTER IS PURGED VIA A PURGE LINE THAT RUNS TO THE CARBURETOR OR AIR CLEANER.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A.

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BOOKS 1-3 ARE HS-023 169--HS-023 171; BOOKS 5-7 ARE HS-023 173--HS-023 175.

Availability: NTIS

HS-023 173

#### **MOTOR VEHICLE EMISSIONS CONTROL. BOOK 5: EXHAUST GAS RECIRCULATION SYSTEMS. FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL MATERIAL, THIS GUIDE IS ONE OF A SERIES OF SEVEN DESIGNED SPECIFICALLY TO TEACH THE

CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL SYSTEMS TO ASSIST THE PRACTICING OR HOME MECHANIC BETTER TO UNDERSTAND THE EXHAUST GAS RECIRCULATION (EGR) SYSTEMS WHICH ARE AN INTEGRAL PART OF AUTOMOBILES TODAY. THE PURPOSE OF THE EGR SYSTEM IS TO SUPPLY, IN THE PROPER PROPORTION, INERT EXHAUST GAS TO THE AIR/FUEL MIXTURE IN THE INTAKE MANIFOLD. THIS DILUTION OF THE AIR/FUEL MIXTURE REDUCES PEAK FLAME TEMPERATURES DURING COMBUSTION AND REDUCES THE AMOUNT OF OXIDES OF NITROGEN (NO<sub>x</sub>) IN THE EXHAUST. THE MAIN COMPONENTS OF THE SYSTEM ARE THE FOLLOWING: EGR VALVE, INTAKE MANIFOLD, CARBURETOR SIGNAL PORT OR A VENTURI VACUUM SIGNAL TAP, AND A TEMPERATURE-CONTROLLED VACUUM VALVE. THE SYSTEM BEGINS TO OPERATE WHEN A SIGNAL FROM THE MANIFOLD VACUUM REACHES THE EGR VALVE. VACUUM CAN BE SENSED AND DIRECTED TO THE EGR VALVE BETWEEN IDLE AND FULL THROTTLE ENGINE OPERATIONS. THE EGR SYSTEM WILL NOT OPERATE AT IDLE OR FULL THROTTLE, BUT ONLY BETWEEN THESE TWO CONDITIONS. HOWEVER, A VACUUM SIGNAL CANNOT REACH THE EGR VALVE UNDER ANY CONDITIONS UNTIL THE RADIATOR TOP TANK TEMPERATURE OR ENGINE COOLANT TEMPERATURE HAS REACHED APPROXIMATELY 60° F. THIS ASSURES GOOD COLD ENGINE DRIVEABILITY. WHEN IN OPERATION, THE EGR SYSTEM WILL DIVERT A REGULATED AMOUNT OF EXHAUSTED GASES FROM THE EXHAUST MANIFOLD BACK INTO THE INTAKE MANIFOLD TO BE MIXED WITH THE FRESH AIR/FUEL CHARGE. THIS REDUCES COMBUSTION TEMPERATURES AND HELPS ELIMINATE NO<sub>x</sub> FROM AUTO EMISSIONS.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A. BARRETT  
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 EPA-T008135-01-0; EPA-T900621-01-0  
 Rept. No. EPA-450/3-77-041; 1977; 66P  
 BOOKS 1-4 ARE HS-023 169--HS-023 172; BOOKS 6-7 ARE HS-023 174--HS-023 175.  
 Availability: NTIS

## HS-023 174

**MOTOR VEHICLE EMISSIONS CONTROL. BOOK 6: SPARK CONTROL SYSTEMS. FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL MATERIAL, THIS GUIDE IS ONE OF A SERIES OF SEVEN DESIGNED SPECIFICALLY TO TEACH THE CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL SYSTEMS TO ASSIST THE PRACTICING OR HOME MECHANIC BETTER TO UNDERSTAND THE SPARK CONTROL SYSTEMS WHICH ARE AN INTEGRAL PART OF AUTOMOBILES TODAY. THE PURPOSE OF THE SPARK CONTROL SYSTEM IS TO CONTROL THE ADVANCE AND RETARD OF THE IGNITION SPARK TO IMPROVE COMBUSTION AND REDUCE THE FORMATION OF HYDROCARBONS AND OXIDES OF NITROGEN (NO<sub>x</sub>) DURING VARYING ENGINE OPERATIONS. THE SYSTEM'S MAIN COMPONENTS ARE THE COOLANT TEMPERATURE SWITCH, THE HOT OVER-RIDE SWITCH, THE TRANSMISSION SWITCH, AND

THE VACUUM ADVANCE SOLENOID VALVE. THE SPARK CONTROL SYSTEM OPERATES TO ALLOW VACUUM ADVANCE WHEN THE COOLANT TEMPERATURE IS COLD, OR WHEN THE TRANSMISSION IS IN HIGH GEAR. AT OTHER TIMES, THE SPARK IS IN RETARD POSITION WHICH INCREASES EXHAUST GAS TEMPERATURE, PROMOTING ADDITIONAL BURNING OF HYDROCARBONS IN THE EXHAUST MANIFOLD. RETARDED SPARK WILL ALSO LOWER PEAK COMBUSTION TEMPERATURE BY IGNITING SPARK LATER IN THE CYCLE, THEREBY REDUCING NO<sub>x</sub> FORMATION.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A. BARRETT

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 BOOKS 1-5 ARE HS-023 169--HS-023 173; BOOK 7 IS HS-023 175.

Availability: NTIS

## HS-023 175

**MOTOR VEHICLE EMISSIONS CONTROL. BOOK 7: CATALYTIC CONVERTER SYSTEMS. FINAL REPORT**

DESIGNED TO BE USED AS SELF-INSTRUCTIONAL MATERIAL, THIS GUIDE IS ONE OF A SERIES OF SEVEN DESIGNED SPECIFICALLY TO TEACH THE CONCEPTS OF AUTOMOBILE EMISSIONS CONTROL SYSTEMS TO ASSIST THE PRACTICING OR HOME MECHANIC BETTER TO UNDERSTAND THE CATALYTIC CONVERTER SYSTEMS WHICH ARE AN INTEGRAL PART OF AUTOMOBILES TODAY. CATALYTIC CONVERTER SYSTEMS REDUCE THE AMOUNT OF HYDROCARBONS (HC) AND CARBON MONOXIDE (CO) GAS IN AUTOMOBILE EMISSIONS BY PROVIDING AN ADDITIONAL AREA FOR EXHAUST GASES TO OXIDIZE OR BURN. THIS IS ACCOMPLISHED BY USING A CHEMICAL CATALYST TO SPEED UP THE OXIDIZING PROCESS. THE SYSTEM'S MAIN COMPONENTS ARE THE OUTER SHELL, A MONOLITH ELEMENT, ALUMINUM OXIDE PELLETS, AND PLATINUM AND PALLADIUM. AS EXHAUSTED GAS LEAVES THE MANIFOLD IT ENTERS THE CATALYTIC CONVERTER WHERE IT IS DIRECTED TO FLOW OVER THE INTERIOR MONOLITH OR PELLETS COVERED BY THE CATALYTIC AGENTS PLATINUM AND PALLADIUM. THE EXHAUST GASES INCREASE THEIR TEMPERATURES AND CONTINUE TO OXIDIZE, REMOVING HC AND CO EMISSIONS FROM THE EXHAUST BEFORE IT ENTERS THE MUFFLER. AS THE HEAT DEVELOPED IN THE CATALYTIC CONVERTERS IS VERY HIGH, AUTO MANUFACTURERS ARE DEVISING VARIOUS METHODS OF CONTROL AND INSULATION TO ENSURE SAFE OPERATION OF THE CONVERTERS.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI; R. A. BARRETT

COLORADO STATE UNIV., DEPT. OF INDUSTRIAL SCIENCES, FORT COLLINS, COLO. 80523  
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 BOOKS 1-6 ARE HS-023 169--HS-023 174.

Availability: NTIS

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HS-023 178

HS-023 176

## A PRIMER ON AUTO EMISSIONS SYSTEMS FOR HOME MECHANICS. FINAL REPORT

INFORMATION TO ACQUAINT THE AVERAGE HOME MECHANIC WITH THE BASIC EMISSIONS CONTROL SYSTEMS AND COMPONENTS INSTALLED ON TODAY'S CARS IS PRESENTED. THIS GUIDE IS INTENDED TO PROVIDE A BASIC KNOWLEDGE AND UNDERSTANDING OF THE FOLLOWING EMISSIONS CONTROL SYSTEMS: POSITIVE CRANKCASE VENTILATION (PCV) SYSTEMS, THERMOSTATIC AIR CLEANER (TAC) SYSTEMS, AIR INJECTION REACTION (AIR) SYSTEMS, FUEL EVAPORATIVE CONTROL (FEC) SYSTEMS, EXHAUST GAS RECIRCULATION (EGR) SYSTEMS, CATALYTIC CONVERTERS, AND OTHER EMISSIONS SYSTEMS (SPARK TIMING CONTROLS, OSAC (ORIFICE SPARK ADVANCE CONTROL) VALVE, VACUUM ADVANCE SHUTOFF, DUAL DIAPHRAGM VACUUM ADVANCE UNIT, CTO (COOLANT TEMPERATURE OVERRIDE) SWITCH). EMPHASIS IS PLACED ON THE FACT THAT EMISSIONS CONTROL EQUIPMENT HAS BEEN INSTALLED TO REDUCE THE AMOUNT OF POLLUTION DISCHARGED TO THE ATMOSPHERE FROM AUTOMOBILES AND THUS PROTECT THE HEALTH OF PEOPLE. BASIC STEP-BY-STEP PROCEDURES TO CHECK OUT VARIOUS COMPONENTS RELATED TO EMISSIONS CONTROL ARE GIVEN. APPENDED IS A LIST OF AVAILABILITY AND COST OF SERVICE MANUALS FROM AMERICAN MOTORS CORP., CHRYSLER CORP., DATSUN, FORD MOTOR CO., GENERAL MOTORS CORP., AND HONDA.

by B. D. HAYES; M. T. MANESS; R. A. RAGAZZI  
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EPA-T900621-01-0

Rept. No. EPA-450/3-77-043; 1977; 100P  
SEE ALSO HS-023 169--HS-023 175.

Availability: NTIS

HS-023 177

## VEHICLE SAFETY TELEMETRY FOR AUTOMATED HIGHWAYS. FINAL REPORT

THE CONCEPT OF AUTOMATED HIGHWAYS, PROVIDING THE MEANS FOR MOTOR VEHICLES TO TRAVEL BETWEEN INTERURBAN CENTERS WITHOUT ACTIVE DRIVER PARTICIPATION, HAS BEEN FORWARDED BY MANY INVESTIGATORS. BREAKDOWNS OF THE VEHICLES USING SUCH A HIGHWAY COULD BE HAZARDOUS TO LIFE OR, AT THE LEAST, INTERRUPT TRAFFIC FLOW; AND THE PROPER OPERATION OF A VEHICLE APPROACHING AN AUTOMATED HIGHWAY WOULD HAVE TO BE ASSESSED TO A HIGH DEGREE OF CERTAINTY BEFORE THAT VEHICLE COULD BE ALLOWED ENTRY. THE CURRENT STATE OF THE ART OF AUTOMATIC VEHICLE TESTING AND DIAGNOSIS WAS INVESTIGATED, AND IT WAS DETERMINED THAT THE EMPHASIS IS PRIMARILY CENTERED ON THE PROPER OPERATION OF THE ENGINE. LATERAL AND LONGITUDINAL GUIDANCE TECHNOLOGIES, INCLUDING SPEED CONTROL AND HEADWAY SENSING FOR COLLISION AVOIDANCE, WERE REVIEWED. THE PRINCIPAL GUIDANCE TECHNIQUE IS THE BURIED WIRE. THE SENSORS

FOR AUTOMOTIVE LATERAL GUIDANCE ARE NOT COMMON TO ANY OTHER VEHICULAR SENSOR SYSTEMS WHILE LONGITUDINAL GUIDANCE, SPEED, AND HEADWAY CONTROLS SHARE SIMILAR BASIC ELEMENTS IN THE ENGINE FUEL SUPPLYING AND BRAKING AREAS. THESE TECHNOLOGIES WERE REVIEWED TO ESTIMATE THE SORT OF CRITERIA THAT SHOULD BE ESTABLISHED IN ALLOWING OR DENYING ENTRY OF VEHICLES TO AN AUTOMATED HIGHWAY. THE CRITERIA FOR REJECTING VEHICLES, ON THE BASIS THAT ALL SUBSYSTEMS ARE NOT WORKING CORRECTLY, CAN BE ESTABLISHED BY WAYSIDE OR ON-BOARD CHECKOUT OR DIAGNOSTIC SYSTEMS. DENIAL OF ENTRY TO A VEHICLE, BASED ON THE ESTIMATE THAT IT PROBABLY CANNOT COMPLETE THE JOURNEY, REQUIRES AN ASSESSMENT OF THE REMAINING OPERATING LIFE IN ALL CRITICAL OPERATING SUBSYSTEMS OR ELEMENTS. THIS REQUIRES THAT HISTORICAL REPLACEMENT DATA AND DEGREE OF USAGE BE PROVIDED, AS WELL AS THE SUBSYSTEMS OPERATIONAL CHECKS BEING PERFORMED, BEFORE AN ESTIMATE CAN BE MADE THAT A PARTICULAR VEHICLE IS LIKELY TO FAIL. THE SENSED INDICATIONS ALONE, WITHOUT THE PARTS LIFE DATA, APPEAR INSUFFICIENT TO ESTABLISH THAT ENTRY IS WARRANTED. SEVERAL POSSIBLE CONFIGURATIONS OF ON-BOARD SAFETY-TELEMETRY PROCESSING EQUIPMENT IN RELATION TO OTHER VEHICULAR ELECTRONIC SUBSYSTEMS, LEADING TO A PROPOSED UNIFIED BUS SYSTEM OF DISTRIBUTED PROCESSORS FOR ACCOMPLISHING THE VARIOUS FUNCTIONS AND TESTING, ARE DISCUSSED. APPENDED IS A SURVEY OF THE VARIOUS AUTOMOTIVE SENSORS (PRESSURE, TEMPERATURE, AND SPECIAL (E.G. AUTOMATIC TIRE INSPECTION)) IN USE OR BEING DEVELOPED FOR THE AUTOMOTIVE INDUSTRY TODAY.

by GEORGE R. HANSEN  
JET PROPULSION LAB., 4800 OAK GROVE DRIVE,  
PASADENA, CALIF. 91103  
DOT-AS-70012; NAS7-100-T.O.-RD152-AMEND-152  
Rept. No. DOT-TST-77-82; 1977; 93P 60REFS  
REPT. FOR DEC 1976-SEP 1977.

Availability: NTIS

HS-023 178

## METAL SUPPORTED CATALYSTS FOR AUTOMOTIVE APPLICATIONS

A HIGH PERFORMANCE ALLOY, FECRALLOY STEEL (15%-20% CHROMIUM, 4%-5% ALUMINUM, 0.1%-0.3% YTTRIUM, AND IRON), IS USED AS THE SUBSTRATE OF A PRECIOUS-METAL CATALYST SYSTEM. CONVERSION OF THIS ALLOY INTO A DURABLE CATALYST TO RENDER IT COMPATIBLE WITH EXISTING CATALYSTS AND PRODUCTION PROCEDURES IS DISCUSSED. THERE IS FLEXIBILITY IN PROCESSING WITH RESPECT TO KEY DESIGN FEATURES (I.E. CELL DENSITY AND TOTAL VOLUME). SUPPORT VARIABLES SUCH AS CELL DENSITY AND VOLUME INFLUENCE THE PERFORMANCE OF AN OXIDATION CATALYST AND A CERAMIC-SUPPORTED CATALYST. AT ZERO HOURS, EQUIVALENT PERFORMANCE, AT NO POWER LOSS PENALTY RELATIVE TO CERAMICS, CAN BE SECURED BY JUDICIOUS CHOICE OF CELL

DENSITY/VOLUME COMBINATIONS. SUCH EQUIVALENCE CAN BE ACHIEVED WITH SIGNIFICANTLY LOWER VOLUMES, AND SIGNIFICANT SCOPE EXISTS FOR FURTHER OPTIMIZATION. CELL DENSITY PLAYS A KEY ROLE; AN OPTIMUM VALUE IS IN THE REGION OF 500 CELLS PER SQUARE INCH. PLATINUM/PALLADIUM OXIDATION CATALYSTS CURRENTLY IN MASS PRODUCTION SHOW GOOD DURABILITY CHARACTERISTICS WHEN DEPOSITED ON TWO TYPES OF METALLIC SUBSTRATES. SUCH CATALYSTS SHOW CHARACTERISTICS COMPARABLE TO PRESENTLY ACCEPTED CERAMIC-SUPPORTED EMISSIONS CATALYSTS. DATA INDICATE THAT ON TECHNICAL GROUNDS, METAL-SUPPORTED CATALYSTS MAY BE CONSIDERED AS ALTERNATIVES TO CURRENT CERAMIC MONOLITH AND PELLET-SUPPORTED CATALYSTS. FURTHERMORE, METAL SUPPORTS OFFER GREAT FLEXIBILITY IN THE DESIGN OF EMISSIONS CONCEPTS SINCE THE PACKAGE MAY BE EASILY TAILORED TO ACHIEVE SPECIFIC PRESSURE DROP/CONVERSION TARGETS BY JUDICIOUS CHOICE OF SUPPORT VOLUME AND CELL DENSITY. THE GOOD PERFORMANCE SHOWN BY SUCH SYSTEMS AT SMALL VOLUMES INDICATES CONSIDERABLE POTENTIAL FOR LIMITED SPACE APPLICATIONS, E.G. STARTER CATALYSTS AND DOWNPipe SYSTEMS AS WELL AS MORE CONVENTIONAL POSITIONS.

by C. A. DULIEU; W. D. J. EVANS; R. J. LARBEY; A. M. VERRALL; A. J. J. WILKINS; J. H. POVEY  
JOHNSON MATTHEY CHEMICALS LTD.; MATTHEY BISHOP, INC.

Rept. No. SAE-770299; 1977; 11P 17REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

#### DEVELOPMENT OF A LEAN BURN/LEAN REACTOR ENGINE SYSTEM THROUGH THE APPLICATION OF ENGINE DYNAMOMETER MAPPING TECHNIQUES

DYNAMOMETER STUDIES WERE CONDUCTED TO DETERMINE THE INDIVIDUAL CHARACTERISTICS OF EACH COMPONENT OF A LEAN BURN/LEAN REACTOR ENGINE SYSTEM (2.3L FOUR-CYLINDER ENGINE) AND EVALUATE ITS PERFORMANCE FOR INCORPORATION INTO THE TOTAL SYSTEM, AND TO PROVIDE AN ESTIMATE OF DRIVEABILITY, EMISSIONS, AND FUEL ECONOMY POTENTIAL FOR THE TOTAL LEAN BURN/LEAN REACTOR ENGINE SYSTEM. THE FOLLOWING COMPONENTS WERE EVALUATED AT IMPORTANT CVS (CONSTANT VOLUME SAMPLER) SPEED/LOAD POINTS ON AN ENGINE DYNAMOMETER: MODIFIED INTAKE MANIFOLD, THERMAL REACTORS, EXHAUST PORT LINERS, AND A MODIFIED COMBUSTION CHAMBER. THE MODIFIED INDUCTION SYSTEM (EXHAUST HEATED INTAKE MANIFOLD) DID NOT SIGNIFICANTLY EXTEND THE LEAN MISFIRE LIMIT OF THE 2.3L FOUR-CYLINDER ENGINE. USE OF THE EXHAUST HEATED INTAKE MANIFOLD DESIGN ON THE 2.3L FOUR-CYLINDER ENGINE COULD SIGNIFICANTLY DECREASE BORDERLINE SPARK ADVANCE RESULTING IN HIGHER

OVERALL FUEL CONSUMPTION. UTILIZATION OF THE FAST FLAME PROPAGATION CHAMBER DESIGN DID NOT EXTEND THE LEAN MISFIRE LIMIT AND INDICATES THAT THE 2.3L FOUR-CYLINDER ENGINE'S LEAN A/F (AIR/FUEL) RATIO LIMIT IS CONTROLLED MORE BY MIXTURE PREPARATION (OR SOME OTHER ENGINE DESIGN VARIABLE AFFECTING FLAME INITIATION AND PROPAGATION) THAN FLAME PROPAGATION DISTANCE. AT MBT (MINIMUM SPARK FOR BEST TORQUE)/BORDERLINE SPARK ADVANCE, CAST-IN EXHAUST PORT LINERS DID NOT SIGNIFICANTLY REDUCE HC (HYDROCARBON) EMISSIONS WITH A PRODUCTION EXHAUST MANIFOLD, BUT DID INCREASE TIME AVERAGE PORT TEMPERATURES APPROXIMATELY 75° TO 100° F AT THE SPEED/LOAD POINTS STUDIED. THERMAL REACTOR VOLUMES GREATER THAN OR EQUAL TO ENGINE DISPLACEMENT MUST BE USED FOR SIGNIFICANT (50%-70% EFFICIENCY) HC OXIDATION. BELOW A 1.0 GRAM/MILE NITROGEN OXIDES (NOX) EMISSION LEVEL, THE 2.3L CONVENTIONAL HC/CO (CARBON MONOXIDE) SYSTEM WOULD BE EXPECTED TO HAVE BETTER ENGINE RESPONSE CHARACTERISTICS AND FUEL ECONOMY THAN THE 2.3L LEAN BURN/LEAN REACTOR SYSTEM. POTENTIALLY UNACCEPTABLE ENGINE RESPONSE CAN BE EXPECTED FOR THE 2.3L LEAN BURN/LEAN REACTOR SYSTEM CONCEPT BELOW THE 1976 FEDERAL NOX STANDARD OF 3.1 GRAMS/MILE. FINALLY, FUEL ECONOMY BENEFITS WITH THE LEAN BURN/LEAN REACTOR ENGINE SYSTEM AT TODAY'S EMISSION STANDARDS (1.5 HC, 15 CO, 2.0 NOX) CANNOT BE REALIZED UNTIL ENGINE STABILITY AND RESPONSE AT LEAN A/F RATIOS IS IMPROVED.

by R. C. MEIER  
FORD MOTOR CO.

Rept. No. SAE-770300; 1977; 25P 15REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

#### DEVELOPMENT AND EVALUATION OF ALUMINUM BODY SHEET METAL PANELS

A DEVELOPMENTAL APPROACH WAS ADOPTED TO ESTABLISH ALUMINUM AS A VIABLE BODY SHEET MATERIAL FOR MOTOR VEHICLE WEIGHT REDUCTION. INITIALLY, BOTH THE MATERIAL ADVANTAGES OF ALUMINUM, AS WELL AS CERTAIN LIMITING FACTORS FOR AUTOMOTIVE PROCESSING WERE RECOGNIZED. ALUMINUM SHEET HAS NATURAL ADVANTAGES, COMPARED TO MANY MATERIALS, AS A WEIGHT-REDUCING AGENT IN THE AUTOMOBILE. ITS SPECIFIC WEIGHT IS ABOUT ONE THIRD THAT OF STEEL, AND STRENGTHS OF ITS CANDIDATE ALLOYS RIVAL THOSE OF STEEL BODY SHEET. THE TECHNOLOGY FOR PROCESSING IT EXISTS, AND NO MAJOR FACILITY CHANGES ARE REQUIRED. IT CAN BE FORMED BY STAMPING, A PROCESS FAMILIAR TO THE INDUSTRY. FURTHERMORE, IT CAN BE WELDED, SANDED, AND PAINTED MUCH THE SAME AS IS DONE WITH PRESENT MATERIALS. ALSO, IT IS HIGHLY CORROSION RESISTANT, A PROPERTY THAT IS VERY DESIRABLE IN

TODAY'S ENVIRONMENT. ON THE OTHER HAND, STYLING OPTIONS ARE REDUCED FROM THAT OF STEEL, BECAUSE ALUMINUM IS LESS FORMABLE. DIE CONSIDERATIONS TO ACCOMMODATE THE FORMABILITY CHARACTERISTICS OF ALUMINUM INCLUDE INCREASED DRAW AND BEND RADII, A SMOOTHER BINDER DEPRESSION, AND A LARGER BLANK SIZE TO ALLOW A GREATER DRAW-TO-STRETCH RATIO IN THE RESULTING FORMED PANEL. IN ADDITION, GREATER SPRINGBACK OF ALUMINUM DICTATES THAT DIES AND PUNCHES BE DESIGNED WITH OVERCROWN BEYOND THAT USED FOR STEEL TO ACHIEVE A DESIGNATED PANEL SHAPE. A THICKNESS INCREASE IS GENERALLY REQUIRED FOR ALUMINUM TO PROVIDE THE STRUCTURAL EQUIVALENCE OF A STEEL PANEL. JOINING OF ALUMINUM BODY PANELS REPRESENTS THE LARGEST POINT OF TECHNICAL DIFFICULTY. THE DEVELOPMENT PROGRAM WAS INITIATED TO INVESTIGATE ALUMINUM BODY SHEET METAL WEIGHT REDUCTION OPPORTUNITIES IN RESPONSE TO INDUSTRY, GOVERNMENT, AND ENVIRONMENTAL PRESSURES FOR IMPROVED FUEL ECONOMY. A MAJOR PLANT TRIAL WAS CONDUCTED AND METHODS OF RESOLVING BOTH FUNCTIONAL AND PROCESSING ISSUES EVOLVED. THE IN-PLANT TRYOUT AND SUBSEQUENT FIELD EVALUATION OF HOOD PANELS PRODUCED USEFUL INFORMATION ON FORMING, WELDING, METAL FINISHING AND PAINTING AS WELL AS APPEARANCE AND FUNCTIONAL ELEMENTS PERTINENT TO PRODUCT FIELD PERFORMANCE. PANELS FROM THIS TRIAL WERE EVALUATED AT INTERVALS DURING TWO YEARS OF EXPOSURE TO DEMANDING FIELD CONDITIONS. DURING THIS SAME PERIOD, LABORATORY EFFORTS RESOLVED REMAINING, LESS CRITICAL ISSUES.

by R. C. EISSINGER; N. H. JEWELL; J. L. LIVERMORE  
FORD MOTOR CO.  
Rept. No. SAE-770303; 1977; 21P 4REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-023 181

#### A CHARACTERIZATION OF EXHAUST EMISSIONS FROM LEAN BURN, ROTARY, AND STRATIFIED CHARGE ENGINES

THE EMISSIONS PATTERNS OF THREE NON-CATALYST TECHNOLOGIES IN CONTRAST TO THOSE FROM A CONVENTIONAL OXIDATION CATALYST CONTROL SYSTEM ARE PRESENTED. A CHARACTERIZATION OF EXHAUST EMISSIONS IS PROVIDED FOR TWO CHRYSLER ELECTRONIC LEAN-BURN CARS, A HONDA CVCC STRATIFIED CHARGE ENGINE, AND A MAZDA RX-4 ROTARY ENGINE. THE EXHAUST EMISSIONS FROM THESE VEHICLES ARE COMPARED TO THOSE FROM A CHRYSLER EQUIPPED WITH AN OXIDATION CATALYST AND AN AIR PUMP. THIS CHARACTERIZATION STUDY OF EMISSIONS INCLUDED MEASUREMENTS OF THE FOLLOWING GASES AND PARTICULATE MATTER: HC (HYDROCARBONS), CO (CARBON MONOXIDE), NOX (NITROGEN OXIDES), HCN (HYDROGEN CYANIDE),

H<sub>2</sub>S (HYDROGEN SULFIDE), COS (CARBONYL SULFIDE), ALDEHYDES, SULFATE, PARTICULATE MATTER, SO<sub>2</sub> (SULFUR DIOXIDE), DETAILED HYDROCARBONS, AND PARTICULATE CARBON AND HYDROGEN. IT WAS FOUND THAT SULFATE EMISSIONS FROM THE NONCATALYST TEST VEHICLES WERE FROM 50% TO ABOUT 90% LOWER THAN THOSE FROM THE AIR-INJECTED CATALYST TEST VEHICLE. HC EMISSIONS FROM THE NONCATALYST TEST VEHICLES DISPLAYED A HIGHER LEVEL OF REACTIVITY THAN THOSE FROM THE CATALYST VEHICLE. THE EXTENT OF ALDEHYDE EMISSIONS APPEARED DIRECTLY RELATED TO THE EXTENT OF HC EMISSIONS FROM THE VEHICLES TESTED. H<sub>2</sub>S EMISSIONS WERE QUITE LOW FROM ALL VEHICLES EXAMINED. HCN EMISSIONS FROM THE NON-CATALYST VEHICLES WERE SIGNIFICANTLY HIGHER THAN THOSE FROM THE CATALYST VEHICLE.

by PETER A. GABELE; JAMES N. BRADDOCK; RONALD L. BRADOW  
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Rept. No. SAE-770301; 1977; 16P 10REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.  
Availability: SAE

HS-023 182

#### BIMETALLIC ALUMINUM/STEEL AUTO BODY PANELS [WARPING, CORROSION]

RESULTS ARE PRESENTED OF SALT SPRAY TESTS TO STUDY THE EFFECTS OF VARIOUS PRETREATMENT CHEMICALS, JOINING METHODS, AND PRIMERS ON BIMETALLIC 5182 ALUMINUM/1010 STEEL AUTO BODY PANELS WITH RESPECT TO WARPING IN PAINT BAKE CYCLE, PAINT PEELING, AND OTHER CORROSION EFFECTS. IT WAS FOUND THAT PANELS PRIMED BY ELECTRODEPOSITION PERFORMED BETTER THAN PANELS WHICH WERE SPRAY PRIMED. INSULATED PANELS PERFORMED BETTER THAN NONINSULATED, WHETHER SPRAY PRIMED OR ELECTROCOATED. OF THE FOUR PRETREATMENTS (FINE-GRAINED ZINC PHOSPHATE COATING FOR STEEL, MICROCRYSTALLINE ZINC PHOSPHATE COATING FOR BOTH STEEL AND ALUMINUM, IRON PHOSPHATE COATING FOR STEEL, AND A CHROME OXIDE TREATMENT FOR STEEL AND ALUMINUM) USED ON THE PANELS, ALL PERFORMED EQUICALLY WELL. ON ADHESIVE BONDED TESTS OF SINGLE OVERLAP PANELS, IT WAS FOUND AGAIN THAT THE PRETREATMENT MADE NO APPRECIABLE DIFFERENCE IN THE DURABILITY RESULTS. HOWEVER, THE PANELS WHICH WERE NOT INSULATED EXHIBITED MORE CORROSION THAN THE INSULATED PANELS IN THE BOND AREA. IN OTHER TESTS TO STUDY THE EFFECTS OF DIFFERENT PRETREATMENT CHEMICALS NOT PREVIOUSLY EVALUATED (ALKALINE CLEAN, CHROMATE; ALKALINE CLEAN, ZINC PHOSPHATE; ALKALINE CLEAN, MICROCRYSTALLINE CALCIUM ZINC PHOSPHATE), MICROCRYSTALLINE CALCIUM ZINC PHOSPHATE PRETREATMENT PERFORMED WELL WITH BOTH SPRAY-APPLIED EPOXY AND ALKYD PRIMERS. IT WAS ALSO FOUND THAT WARPING OF ALU-

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MINUM/STEEL BIMETALLIC COMPONENTS WILL OCCUR IF A HIGH-STRENGTH ADHESIVE CURED IN A PAINT BAKE CYCLE IS USED TO BOND THE PANELS. THE WARPING IS DUE TO THE DIFFERENCE IN THERMAL EXPANSION OF THE ALUMINUM AND STEEL. IF PANELS ARE FIXED BEFORE GOING INTO THE PAINT BAKE CYCLE BY MECHANICAL MEANS, NO WARPING OCCURS. ONLY TWO ADHESIVES WERE FOUND EFFECTIVE TO STOP WARPING, A SILANE PRIMER AND A TWO-PART EPOXY. FROM A PAINT PEELING STANDPOINT, THE MECHANICAL HEM FLANGE PERFORMED BEST. STAPLING AND RESISTANCE WELDING ON A DOWN FLANGE WERE ALSO GOOD. ADHESIVE-BONDED HEM FLANGES PERFORMED POOREST. ALL PANELS EXHIBITED PAINT PEELING AFTER 1000 HOURS SALT SPRAY, EVEN THOUGH THEY WERE SPRAY PRIMED WITH AN EPOXY PRIMER. APPARENTLY THE EPOXY PRIMER BREAKS DOWN AFTER 500 HOURS AND CAUSES PAINT PEELING. SAPONIFICATION OF THE PRIMER IS THE MAIN CAUSE OF PAINT PEELING IN BIMETALLIC PANELS; THE USE OF MICROCRYSTALLINE CALCIUM ZINC PHOSPHATE PRETREATMENT AND EPOXY PRIMERS APPEARS TO RETARD THIS REACTION SIGNIFICANTLY.

by MICHAEL A. GLAGOLA

REYNOLDS METALS CO.

Rept. No. SAE-770304; 1977; 11P

PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 183

#### SAFETY AND HEALTH IN AUTO BODY REPAIR SHOPS. GOOD PRACTICES FOR EMPLOYEES

THIS GUIDE PRESENTS GOOD HEALTH AND SAFETY PRACTICES FOR WORKERS IN AUTO BODY REPAIR SHOPS, CAR AND TRUCK DEALERSHIPS, TRUCK FLEET MAINTENANCE DEPOTS, AND SIMILAR PLACES OF WORK. THE FIRST SECTION CONCERNSS THE RECOGNITION OF SAFETY AND HEALTH HAZARDS AND INCLUDES INFORMATION ON HOUSEKEEPING, WELDING, GRINDERS, HYDRAULIC JACKS, HYDRAULIC LIFTS, HAND TOOLS, AIR CONTAMINANTS (WELDING, CARBON MONOXIDE (CO), ASBESTOS), EPOXY PLASTICS, SOLVENTS, SPRAY PAINTING, PAINT AND SOLVENT TRANSFER, NOISE, GLAZING, RADIATOR AND AIR CONDITIONING REPAIR, AND FUEL TANKS. A SECOND SECTION PROVIDES INFORMATION ON PERSONAL PROTECTIVE EQUIPMENT (SAFETY SHOES, GLOVES, EYE AND FACE PROTECTION, RESPIRATORY PROTECTION, AND EAR PROTECTION). ALSO BRIEFLY CONSIDERED ARE FIRE SAFETY AND FIRST AID.

NATIONAL INST. FOR OCCUPATIONAL SAFETY AND HEALTH, 4676 COLUMBIA PKWY., CINCINNATI, OHIO 45226

Rept. No. PB-276 677; DHEW(NIOSH)PUB-77-229; 1977; 39P  
Availability: NTIS

HSL 78-11

HS-023 184

#### MOTOR CAR DEFECTS IN IRELAND

A SUMMARY OF MOTOR VEHICLE SAFETY INSPECTION WORK CARRIED OUT DURING 1972-1974 IN IRELAND IS PRESENTED. THE DEVELOPMENT OF INSPECTION STANDARDS, PROCEDURES, AND EQUIPMENT IS OUTLINED; AND STATISTICAL DATA FROM THE INSPECTION OF 3282 CARS IN DUBLIN, SLIGO, MULLINGAR, CORK, AND GALWAY ARE PRESENTED. FROM THE RESULTS OF THE SAFETY INSPECTIONS, IT WAS FOUND THAT 85% OF THE CARS SUBMITTED FOR VOLUNTARY INSPECTION IN DUBLIN HAD ONE OR MORE SIGNIFICANT OR MAJOR SAFETY-RELATED DEFECTS. CARS INSPECTED IN OTHER PARTS OF THE COUNTRY WERE FOUND TO BE IN EVEN WORSE CONDITION. THE DEFECTS FOUND DURING THE INSPECTIONS ARE DESCRIBED IN DETAIL, AS WELL AS THE ROAD SAFETY IMPLICATIONS OF THESE DEFECTS. STEPS THAT THE MOTORIST MAY TAKE TO DETECT AND REMEDY SUCH DEFECTS ARE PROVIDED.

by R. H. SMITH

AN FORAS FORBARTRA (NATIONAL INST. FOR PHYSICAL PLANNING AND CONSTRUCTION RES.), ROAD SAFETY SECTION, ST. MARTIN'S HOUSE, WATERLOO RD., DUBLIN 4, IRELAND

Rept. No. RS-180; 1975; 46P

Availability: CORPORATE AUTHOR 1 POUND

HS-023 185

#### SELECTED GEOMETRIC ELEMENTS AND ACCIDENT DENSITIES ON THE NATIONAL NETWORK [RURAL ROADS IN IRELAND]

THE RELATIONSHIP OF TRAFFIC FLOW AND ROAD GEOMETRY ON THE ACCIDENT FREQUENCY OF RURAL SECTIONS OF THE IRISH NATIONAL ROAD NETWORK WAS EXAMINED BY MULTIPLE REGRESSION ANALYSIS. AS EXPECTED, TRAFFIC VOLUME WAS THE VARIABLE MOST CLOSELY RELATED TO ACCIDENT OCCURRENCE. THE NEXT MOST IMPORTANT INFLUENCE ON THE NUMBER OF ACCIDENTS WAS THE LEVEL OF DEVELOPMENT ALONGSIDE THE ROAD (E.G. FACTORIES, HOTELS, PRIVATE HOUSES). THE ACCIDENT FREQUENCY WAS LOWER ON SECTIONS OF ROAD WITH HARD SHOULDERS THAN ON ROADS WITHOUT SHOULDERS, AFTER ALLOWING FOR THE EFFECTS OF TRAFFIC FLOW AND OF ROADSIDE DEVELOPMENT. ACCIDENT DENSITIES WERE ON AN AVERAGE 25% LOWER WHEN A POISSON DISTRIBUTION OF ACCIDENTS WAS ASSUMED, AND 30% LOWER WHEN A NORMAL DISTRIBUTION WAS ASSUMED. TAKING INTO CONSIDERATION THE EFFECTS OF TRAFFIC FLOW, ROADSIDE DEVELOPMENT, AND PRESENCE OR ABSENCE OF HARD SHOULDERS, THE REGRESSION EQUATION SUGGESTED THAT THERE WAS A MARGINAL INCREASE IN ACCIDENTS WITH AN INCREASE IN ROADWAY WIDTH. THERE ARE SEVERE LIMITATIONS ON ANY POSTFACTUM STATISTICAL MODEL SUCH AS THE MULTIPLE REGRESSION MODEL, AND CONCLUSIONS

November 30, 1978

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FROM SUCH MUST BE VERIFIED BY WELL DESIGNED  
"BEFORE AND AFTER" STUDIES.

by R. HEARNE  
AN FORAS FORBARTHA TEORANTA (NATIONAL INST.  
FOR PHYSICAL PLANNING AND CONSTRUCTION  
RES.), ROAD SAFETY SECTION, ST. MARTIN'S HOUSE,  
WATERLOO RD., DUBLIN 4, IRELAND  
Rept. No. RS-167; 1976; 11P 20REFS  
Availability: CORPORATE AUTHOR

HS-023 186

**MOTOR CARRIER ACCIDENT INVESTIGATION.  
EXXON COMPANY, U.S.A. ACCIDENT--OCTOBER  
14, 1977--CHERRY HILL, NEW JERSEY**

AN ACCIDENT INVOLVING A TRACTOR-CARGO-TANK TRAILER COMBINATION OCCURRED ON 14 OCT 1977 AT 3:10 AM AT INTERSTATE 295 AND STATE ROUTE 70, NEAR A BRIDGE OVERPASS, CHERRY HILL, N.J. THE TRUCK, WHICH WAS TRANSPORTING 8850 GALLONS OF GASOLINE, RAN OFF THE LEFT SIDE OF THE ROAD, STRUCK A GUARDRAIL, THEN CRASHED OVER A CONCRETE WALL AND PLUNGED TO THE ROADWAY BELOW (ROUTE 70); A FIRE ENSUED. AS A RESULT OF THE ACCIDENT, THE DRIVER WAS THROWN FROM THE CAB OF HIS TRACTOR ONTO THE MEDIAN OF ROUTE 70 AND KILLED. THE TRUCK AND CARGO WERE DESTROYED BY FIRE. THE BRIDGE AND APPURTENANCES, THE ROADWAY, AND THE SURROUNDING ENVIRONMENT, INCLUDING PUBLIC UTILITIES, WERE DAMAGED. THE PROPERTY DAMAGE WAS ESTIMATED AT \$395,300. THE OPERATION OF A TRUCK BY A FATIGUED DRIVER WHO FELL ASLEEP AT THE WHEEL WAS THE PROBABLE CAUSE OF THE ACCIDENT. THE DRIVER HAD BEEN DRIVING A TRUCK AND A SCHOOL BUS FOR ABOUT 2 WEEKS PRIOR TO THE ACCIDENT. HIS USUAL TRUCK DRIVING TOUR BEGAN AT 5 P.M. AND ENDED BETWEEN 3:00 AND 3:30 THE FOLLOWING MORNING. HE BEGAN HIS MORNING SCHOOL BUS SCHEDULE AT 8:00. THEREFORE, IT IS HIGHLY IMPROBABLE THAT HE OBTAINED ANY APPRECIABLE REST DURING THIS TIME. INVESTIGATION DISCLOSED THAT SINCE 10 OCT 1977, THE DRIVER HAD NOT TAKEN EIGHT CONSECUTIVE HOURS OFF DUTY AND HAD BEEN ON DUTY 44 HOURS. FURTHER, THE LACK OF EVIDENCE AT THE SCENE THAT THE DRIVER TOOK ANY EVASIVE ACTION PRIOR TO CRASHING INTO THE GUARDRAIL AND MEDIAN CONCRETE WALL, SUPPORTS THE CONCLUSION THAT THE DRIVER WAS ASLEEP AT THE WHEEL.

BUREAU OF MOTOR CARRIER SAFETY,  
WASHINGTON, D.C. 20590  
Rept. No. BMCS-77-3; 1978; 14P  
Availability: CORPORATE AUTHOR

HS-023 187

**CONTROL STRATEGIES FOR SIGNALIZED  
DIAMOND INTERCHANGES. TECHNOLOGY  
SHARING REPORT. TRAFFIC ENGINEERING  
METHOD, FHWA DESIGN MANUAL METHOD,**

**FULLY ACTUATED CONTROL METHOD, MICRO-  
PROCESSOR CONTROL METHOD**

THE COMPARATIVE EFFICIENCY OF FIVE TRAFFIC SIGNAL TIMING CONTROL METHODS AT A DIAMOND INTERCHANGE WAS INVESTIGATED. A "BEFORE" AND "AFTER" EVALUATION OF THE FOLLOWING METHODS WAS MADE BY PAIRING THEM IN A SERIES OF SIX COMPARISONS, USING TIME-LAPSE PHOTOGRAPHY TO SUPPLY VEHICLE DATA: TRAFFIC ENGINEERING METHOD, FHWA (FEDERAL HWY. ADMINISTRATION) DESIGN MANUAL METHOD, FULLY ACTUATED OPERATION METHOD, MICROPROCESSOR WITH LAGGING LEFT-TURN METHOD, AND MICROPROCESSOR WITH LEADING LEFT-TURN METHOD. THE SITE SELECTED FOR APPLICATION OF THESE COMPARISONS WAS THE DIAMOND INTERCHANGE OF INTERSTATE 95 AND GOLFAIR BLVD. IN JACKSONVILLE, FLORIDA. ONE DEFINITE CONCLUSION WAS REACHED AS A RESULT OF THIS STUDY, NAMELY, THAT ONE METHOD OF OPERATION WILL NOT PERFORM BETTER DURING ALL PERIODS OF THE DAY. IT IS APPARENT THAT FROM ONE INTERCHANGE EVALUATION, SUITABLE EQUIPMENT CANNOT BE SELECTED FOR ALL DIAMOND INTERCHANGES. IN ORDER TO EVALUATE THE TYPE OF EQUIPMENT NEEDED TO CONTROL A DIAMOND INTERCHANGE, EXISTING VOLUME AND GEOMETRIC DATA MUST BE USED. TO DEVELOP A STARTING POINT FOR SIGNAL TIMING AND OFFSETS, THE "VOL. 2 DESIGN MANUAL FOR TRAFFIC SIGNAL CONTROL OF DIAMOND INTERCHANGE COMPLEXES" DEVELOPED FOR FHWA IS AN EXCELLENT SOURCE. THIS MANUAL CAN BE USED TO DEVELOP INITIAL CYCLE LENGTHS, SPLITS, AND OFFSETS FOR THE VARYING TRAFFIC CONDITIONS. TIMING PATTERNS MUST BE INSTALLED IN THE FIELD AND ALLOWED TO OPERATE FOR SOME PERIOD OF TIME WITH FIELD ADJUSTMENTS BEING MADE TO THE SETTINGS TO FIT TRAFFIC CONDITIONS. EQUIPMENT SHOULD NOT BE SELECTED ARBITRARILY. SOME FEELING FOR FLUCTUATION OF TRAFFIC, SATURATION FLOW, CAPACITY, AND FUTURE VOLUME LEVELS SHOULD BE DETERMINED PRIOR TO SELECTING EQUIPMENT. FINALLY, WITH THE INCREASING IMPORTANCE OF FUEL CONSUMPTION EFFICIENCY, THE RELATIONSHIP BETWEEN STOPS AND DELAY SHOULD BE EVALUATED BEFORE SELECTING THE TYPE OF OPERATION.

by JOSEPH W. GUYTON; JAMES W. YARBROUGH;  
JEFFREY M. AREY  
HARLAND BARTHOLOMEW AND ASSOCIATES,  
MEMPHIS, TENN. 38103  
Rept. No. FHWA-TS-78-206; 1978; 162P 16REFS  
SPONSORED BY FEDERAL HWY. ADMINISTRATION.  
Availability: GPO

HS-023 188

**WHAT DETROIT WANTS FROM PLASTICS...AND  
VICE-VERSA [AUTOMOTIVE INDUSTRY]**

SOME CHALLENGES THE AUTOMOTIVE INDUSTRY IS PRESENTING TO THE PLASTICS INDUSTRY TO MEET THE AUTO MANUFACTURERS' NEED FOR LIGHTWEIGHT, ENERGY-EFFICIENT, CORROSION-RESISTANT, AND RELATIVELY LOW-COST MATERIALS

FOR THE FUTURE ARE OUTLINED. WHILE NOBODY IN THE AUTO INDUSTRY IS DEMEANING THE PLASTICS INDUSTRY'S CONTRIBUTION, WHICH HAS BEEN CONSIDERABLE, THE CONSENSUS IS THAT MORE IMPROVEMENTS IN MATERIALS, MACHINERY TO MOLD LARGE PARTS FASTER, BETTER ENGINEERING DATA TO PLUG INTO PRODUCT DESIGN EQUATIONS, AND CLASS "A" FINISHES FOR EXTERIOR PARTS OF ALL SHAPES AND SIZES ARE NEEDED. SHEET MOLDING COMPOUND (SMC) IS AN EXAMPLE OF A TRADITIONAL METAL REPLACEMENT MATERIAL NEEDING WORK; E.G. SMC HAS NOT BEEN SUCCESSFUL WHEN APPLIED TO LARGE, FLAT BODY PANELS. DETROIT DESIGNERS WOULD ALSO LIKE TO SEE LIGHTER WEIGHT AND STRONGER SMC'S. HYBRIDS OF GLASS FIBER WITH HIGHER MODULUS CARBON FIBERS NEED THE SAME KIND OF DEVELOPMENT EFFORT. REINFORCED PLASTICS IN GENERAL NEED CONSIDERABLE STUDY IF THEY ARE TO KEEP UP WITH ADVANCED DESIGN METHODS. IN THE CASE OF REACTION INJECTION MOLDED (RIM) PLASTICS, EQUIPMENT DEVELOPMENT AND PROCESSING IMPROVEMENTS ARE THE HIGHEST PRIORITY ITEMS. IF STAMPABLE PLASTICS WERE TO GROW MARKEDLY IN AUTOMOTIVE APPLICATIONS, THE AUTOMOTIVE INDUSTRY IS CONCERNED ABOUT SHEET PRODUCTION CAPACITY. THE AUTO INDUSTRY'S MATERIALS EXPERTS SAY THAT STRUCTURAL FOAM MOLDERS WILL FIND A BONANZA IF STRONGER FOAMS AND LOWER FINISHING SYSTEMS CAN BE DEVELOPED. BESIDES USING PLASTICS FOR METAL REPLACEMENT, PLASTICS SUPPLIERS ARE BEING ENCOURAGED TO DEVELOP OTHER AREAS OF PRODUCT APPLICATION (E.G. CAR WINDOWS). FOR INJECTION AND BLOW MOLDING, DETROIT'S LIST OF NEEDS MAY BE LONGEST AND INCLUDES THE FOLLOWING IMPROVEMENTS IN MOLDING COMPOUNDS: IMPROVED MINERAL-REINFORCED AND GLASS-REINFORCED MATERIALS THAT RESIST WARPING IN PAINT BAKE OVENS, MORE IMPACT-RESISTANT COMPOUNDS, HIGHER TEMPERATURE RESINS FOR UNDER-THE-HOOD APPLICATIONS, IMPROVEMENTS IN FINISHING METHODS, AND BETTER FASTENERS AND ADHESIVES THAT CAN STAND LONG-TERM SERVICE AND LEND THEMSELVES TO EASY REPAIR OR DISASSEMBLY. ON THE OTHER HAND, PLASTICS SUPPLIERS AND MOLDERS HAVE THEIR OWN LIST OF NEEDS WHEN IT COMES TO DEALING WITH THE AUTOMOTIVE INDUSTRY. SOME OF THE PROBLEMS FACED BY THE PLASTICS INDUSTRY INCLUDE NOT GETTING TO MEET THE RIGHT PEOPLE IN THE AUTO INDUSTRY, CENTRALIZED PURCHASING BY THE AUTO INDUSTRY, AND THE TENDENCY FOR SOME CAR DESIGNERS TO TALK PLASTICS BUT THINK METALS.

by PHILIP WEST  
Publ: MODERN PLASTICS V55 N5 P38-41 (MAY 1978)  
1978

Availability: SEE PUBLICATION

### DIRECT PROCESSING OF SUGAR CANE INTO ETHANOL

A PROCEDURE FOR THE DIRECT PROCESSING OF SUGAR CANE TO ETHANOL HAS BEEN DEVELOPED WHICH INVOLVES PRECRUSHING IN A HAMMER MILL, THERMAL TREATMENT, AND EXTRACTION. THE FUNDAMENTAL PRINCIPLE OF THIS PROCEDURE IS TO EXPOSE THE SUGAR CANE TO INCREASED TEMPERATURE AFTER IT HAS BEEN FINELY PULVERIZED IN ORDER TO ENSURE RAPID AND EFFECTIVE BREAKDOWN OF THE PLANT CELL WALLS AND TO RELEASE THE SUGAR. DURING THE THERMAL TREATMENT, THE CONNECTIVE TISSUE BETWEEN PITH CELLS AND FIBERS IS DISSOLVED TO SUCH A DEGREE THAT THE SUGAR IS QUICKLY DIFFUSED INTO THE SURROUNDING FREE SOLUTION. THE SUGAR CAN THEN BE EASILY EXTRACTED FROM THE HOT VEGETABLE MATERIAL. SIGNIFICANT SAVINGS OF INVESTMENT COST CAN BE REALIZED BY THIS PROCESSING METHOD IN COMPARISON TO THAT OF A CONVENTIONAL SUGAR MILL. BESIDES THE RELATIVELY SMALL AMOUNT OF MECHANICAL ENERGY FOR POWERING THE HAMMER MILL AND THE PUMPS, LOW PRESSURE STEAM IS USED FOR THE THERMAL TREATMENT AND DISTILLATION, AND THE TOTAL ENERGY REQUIREMENT CAN BE MET BY BURNING APPROXIMATELY TWO THIRDS OF THE RESIDUE OBTAINED.

by HARTMUT BRUESCHKE  
BALLWEG GAS TECHNOLOGY, INC.,  
PLITTERSDORFER STR. 53A, 5300 BONN-BAD  
GODESBERG, WEST GERMANY

1977; 7P

PRESENTED AT INTERNATIONAL SYMPOSIUM ON ALCOHOL FUEL TECHNOLOGY--METHANOL AND ETHANOL, WOLFSBURG, GERMANY, 21-23 NOV 1977. TEXT ALSO IN GERMAN. SPONSORED BY [GERMAN] FEDERAL MINISTRY FOR SCIENTIFIC COLLABORATION AND CORP. FOR TECHNICAL COLLABORATION.

Availability: REFERENCE COPY ONLY

### BODY LANGUAGE: THE AGONY AND THE ECSTASY OF DRIVING POSITION

THE DESIGN OF A CAR TO ALLOW THE DRIVER TO FUNCTION EASILY AND EFFICIENTLY IS DISCUSSED. HISTORICALLY, THE CAR GREW OUT OF THE HORSE-DRAWN CARRIAGE, WITH THE AID OF ENGINEERS WHOSE INSPIRATION WAS CLEARLY THE RAILWAY LOCOMOTIVE. THE DRIVER BECAME SUBSERVIENT TO THE MACHINE, AND PROVISIONS MADE FOR THE MOTORIST WERE MERELY ELABORATIONS OR ADAPTATIONS OF THE CARRIAGE. WERE THE MOTORIST TRAVELING NO FASTER OR FARTHER TODAY THAN IN EARLIER TIMES, THE SEATING POSITION WOULD BE NO MORE IMPORTANT. HOWEVER, EVERY NEW REQUIREMENT OF TRAFFIC AND TECHNOLOGY SINCE THEN HAS MADE THE DRIVING TASK MORE COMPLEX AND ONEROUS. AT THE WHEEL OF THE CAR, THE DRIVER TODAY IS BADLY CONTORTED, POORLY SUPPORTED, PARTIALLY BLINDED, PROGRESSIVELY DEAFENED, AND CONTINUALLY

November 30, 1978

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AGITATED. PROVISIONS THAT NEED TO BE MADE IN THE DESIGN AND ARRANGEMENT OF THE PEDALS, SEAT, STEERING WHEEL, THE GEAR LEVER, HAND BRAKE, ETC., ARE DISCUSSED IN TERMS OF MEETING THE DRIVER'S PHYSICAL REQUIREMENTS OF SENSATION, CONTROL, AND COMFORT. THE HEADREST SHOULD BE FIXED TO THE CAR RATHER THAN TO THE SEAT, AND SEAT, PEDALS, AND OTHER CONTROLS ADJUSTED SO THAT THE DRIVER'S EYES ARE CORRECTLY POSITIONED. PEDALS NEED TO BE POSITIONED, SHAPED, AND SPACED FOR COMFORTABLE RESTING AND MOVEMENTS OF THE LEGS AND FOR HEEL-AND-TOE BRAKING AND GEAR CHANGING. OPTIMUM SEAT CUSHIONING IS DIFFICULT SINCE DRIVERS VARY CONSIDERABLY IN SHAPE AND SIZE, AND SINCE THE SEATED POSITION IS UNSUITABLE BOTH FOR HUMAN BEINGS AND FOR THE ACTIVITY OF DRIVING. THE STEERING COLUMN AND STEERING WHEEL SHOULD BE SO POSITIONED THAT THE DRIVER'S ARMS SHOULD BE EITHER PARALLEL OR CONVERGING SLIGHTLY TOWARD THE WHEEL.

by L. J. K. SETRIGHT

Publ: CAR AND DRIVER V23 N12 P87-91, 93 (JUN 1978)  
1978

Availability: SEE PUBLICATION

HS-023 191

**THE DEVELOPMENT AND TESTING OF A HIGHLY DIRECTIONAL DUAL-MODE ELECTRONIC SIREN [EMERGENCY VEHICLES]**

A DUAL-MODE DIRECTIONAL ELECTRONIC SIREN HAS BEEN DEVELOPED WHICH CAN BE ELECTRICALLY SWITCHED UNDER MANUAL CONTROL FROM A STRONG NARROW BEAM OF SOUND IN THE FORWARD DIRECTION FOR OPEN HIGHWAY USAGE TO A BROADER BEAM FOR USE NEAR ROADWAY INTERSECTIONS. THE DEVELOPMENT OF THIS SIREN WAS PROMPTED BY THE FACT THAT TRAFFIC ACCIDENTS INVOLVING EMERGENCY VEHICLES TEND TO HAPPEN AT INTERSECTIONS AND ARE AT LEAST PARTLY CAUSED BY THE OCCASIONAL FAILURE OF THE EMERGENCY WARNING DEVICES (SIRENS AND/OR FLASHING LIGHTS) TO EFFECTIVELY WARN CROSS TRAFFIC OF THE EMERGENCY VEHICLE'S APPROACH. THE INTENSE BEAM OF SOUND IS PRODUCED BY A VEHICULAR-ROOF-MOUNTED BROADSIDE ARRAY CONSISTING OF FOUR COMPACT COMMERCIAL 100 WATT ELECTRONIC SIREN LOUD-SPEAKERS SPACED 15.2 CM (6.0 IN) APART. TWO ELECTRONIC SYSTEMS WERE DEVELOPED TO BROADEN THE INHERENTLY NARROW BEAM OF THE BROADSIDE ARRAY. ONE SYSTEM SWEEPS THE BEAM FROM SIDE TO SIDE; THE SECOND SYSTEM INVOLVES THE USE OF A FILTER NETWORK. A WEIGHTED SOUND PRESSURE LEVEL MEASUREMENTS MADE IN AN ANECHOIC CHAMBER AND OUTDOORS ON A VEHICLE SHOWED THAT THE MAXIMUM SOUND PRESSURE LEVEL OF THE DUAL-MODE SIREN IS 7 TO 10 DB HIGHER IN THE DESIRED

DIRECTIONS THAN A SINGLE 100 WATT COMMERCIAL ELECTRONIC SIREN.

by R. L. FISHER; D. D. TOTH; D. S. BLOMQUIST; J. S. FORRER

NATIONAL BUREAU OF STANDARDS, WASHINGTON,  
D.C. 20234  
Rept. No. NBS-SP-480-28; STOCK-NO-003-003-01925-9; 1978;  
53P 7REFS

LAW ENFORCEMENT EQUIPMENT TECHNOLOGY  
REPT. SPONSORED BY THE NATIONAL INST. OF LAW  
ENFORCEMENT AND CRIMINAL JUSTICE.  
Availability: GPO \$2.20, SD CATALOG NO. C13.10:480-28

HS-023 192

**IRON AND STEEL. STANDARDS, RECOMMENDED PRACTICES, INFORMATION REPORTS. 1978 ED.**

RULES, NOMENCLATURE, AND UNIFIED NUMBERING SYSTEM PROCEDURES ARE PROVIDED FOR PREPARATION OF SAE TECHNICAL REPORTS, AS WELL AS THE SAE NUMBERING SYSTEM AND CHEMICAL COMPOSITION STANDARDS OF SAE STEELS, WITH GENERAL DATA ON PROPERTIES AND TREATMENTS OF STEELS. APPROVED STEEL TESTING METHODS ARE EXPLAINED. SPECIFICATIONS ARE PRESENTED FOR STEEL FASTENERS (SCREWS, NUTS, BOLTS, ETC.), SPRING WIRE AND SPRINGS, FERROUS CASTINGS, TOOL AND DIE STEELS, AND FERROUS MATERIALS. GENERAL SPECIFICATIONS ARE PROVIDED FOR METALS, INCLUDING SURFACE TEXTURE, THICKNESS, AND WELDING, BRAZING, AND SOLDERING MATERIALS AND PROCEDURES.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC., 400 COMMONWEALTH DR., WARRENTALE, PA. 15096  
Rept. No. HS-30; 1978; 231P 7REFS

Availability: SAE

HS-023 193

**FLUID CONDUCTORS AND CONNECTORS. STANDARDS, RECOMMENDED PRACTICES, INFORMATION REPORTS. 1978 ED.**

THE CODING SYSTEM FOR IDENTIFICATION OF TUBE, PIPE, AND HOSE FITTINGS IS EXPLAINED, AND SPECIFICATIONS PROVIDED FOR TESTS AND PROCEDURES ON HYDRAULIC AND OIL HOSE AND HOSE ASSEMBLIES, AS WELL AS HYDRAULIC AND REFRIGERATION TUBE FITTINGS. RECOMMENDED PRACTICES ARE GIVEN FOR TREATING VARIOUS TYPES OF STEEL TUBING FOR HYDRAULIC AND AIR BRAKE SYSTEMS, AND FUEL INJECTION. STANDARDS FOR PIPE FITTINGS, AND PLUGS FOR PIPES, FILLERS, AND DRAINS ARE INCLUDED, AS WELL AS STANDARDS FOR LUBRICATION FITTINGS.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC., 400 COMMONWEALTH DR., WARRENTALE, PA. 15096  
Rept. No. HS-150; 1978; 143P

Availability: SAE

HS-023 194

**LIGHTING EQUIPMENT AND PHOTOMETRIC TESTS. STANDARDS, RECOMMENDED PRACTICES, INFORMATION REPORTS. 1978 ED.**

ELECTRICAL EQUIPMENT SPECIFICATIONS INCLUDE THOSE FOR CIRCUIT BREAKERS, IGNITION SWITCHES, SWITCHES FOR WINDSHIELD WASHERS AND WIPERS, AND FOR ELECTRIC BLOWER MOTORS, AND CIGAR LIGHTER RECEPTACLES. TERMINOLOGY AND THE IDENTIFICATION CODE FOR LIGHTING ARE EXPLAINED, AND SPECIFICATIONS PROVIDED FOR HEADLAMP BEAM SWITCHING DEVICES, BULB RETENTION SYSTEMS, CONNECTORS AND PLUGS, AS WELL AS SEALED BEAM HEADLAMP UNITS. SERVICE PERFORMANCE REQUIREMENTS AND TESTS ARE SPECIFIED FOR MOTOR VEHICLE LAMP BULBS, SEALED BEAM HEADLAMPS, LIGHTING DEVICES, AND COMPONENTS. STANDARDS FOR PLASTIC MATERIALS USED IN REFLECTORS AND LENSES, AND IN LIGHTING DEVICE HOUSINGS ARE PROVIDED, AS WELL AS COLOR SPECIFICATIONS FOR SIGNAL LIGHTS. SIMILAR SPECIFICATIONS ARE PROVIDED ON LIGHTING SYSTEMS FOR MOTORCYCLES AND SCHOOL BUSES. HEADLAMP TESTING MACHINES AND AIMING DEVICES ARE DISCUSSED, AS WELL AS IMPACT TESTS FOR LAMPS AND FLASHER TEST EQUIPMENT.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC., 400 COMMONWEALTH DR., WARRENDALE, PA. 15096  
Rept. No. HS-34; 1978; 94P

Availability: SAE

HS-023 195

**RESISTANCE WELDING ALUMINUM FOR AUTOMOTIVE PRODUCTION**

THE FEASIBILITY OF RESISTANCE WELDING ALUMINUM SHEET IN AN AUTOMOTIVE ENVIRONMENT WAS INVESTIGATED, WITH THE EMPHASIS OF THE STUDY ON DEVELOPING WELDING SCHEDULES AND ESTABLISHING PROCEDURES TO ASSURE A SUCCESSFUL INITIAL PRODUCTION RUN AND TO SERVE AS A SPRINGBOARD FOR FUTURE DEVELOPMENT. IT WAS DETERMINED THAT ALUMINUM SHEETS IN THE "AS RECEIVED" MILL CONDITION CANNOT BE RELIABLY RESISTANCE SPOT WELDED ON A PRODUCTION BASIS. ONLY 25 CONSECUTIVE ACCEPTABLE WELDS WERE MADE ON ONE LOT OF "AS RECEIVED" ALUMINUM SHEET UNDER CONTROLLED LABORATORY CONDITIONS WELDING TWO FLAT SPECIMENS TOGETHER. OTHER LOTS OF "AS RECEIVED" ALUMINUM WELDED MUCH BETTER, BUT ONLY ONE OF SIX LOTS PASSED A "WELD RELIABILITY TEST" THAT REQUIRES THAT WELDS PEEL BUTTONS GREATER THAN AN ESTABLISHED MINIMUM DIAMETER THROUGH 2000 CONSECUTIVE WELDS WITHOUT THE NECESSITY OF DRESSING ELECTRODE OR WITHOUT MODIFYING OF THE WELD SCHEDULE PARAMETERS. OF THE MANY METHODS OF SURFACE TREATMENT TRIED PRIOR TO WELDING (CHEMICAL CLEANING, PLATING, SHOT BLASTING, ABRADING), ABRADING WAS FOUND TO BE THE MOST SATISFACTORY. SEVERAL LOTS WELDED SATISFACTORILY 90

DAYS AFTER ABRADING. THE LOT OF ALUMINUM THAT FAILED AT 25 WELDS IN THE "AS RECEIVED" CONDITION PRODUCED 2250 WELDS BEFORE FAILURE AFTER BEING ABRADED. RWMA CLASS I ELECTRODES WITH EXTENDED WATER FLOW PRODUCED OVER TWICE AS MANY SATISFACTORY WELDS WITHOUT ELECTRODE DRESSING AS ANY OTHER MATERIAL TRIED. THE TRUNCATED ELECTRODE (SAME AS USED IN WELDING STEEL) WITH A 76 MM (3 IN) RADIUS WELDING FACE PRODUCED BY FAR THE GREATEST NUMBER OF WELDS WITHOUT ELECTRODE DRESSING. NO SIGNIFICANT DIFFERENCE WAS FOUND IN THE NUGGET FORMATION OF SPOT WELDS MADE WITH AC (ALTERNATING CURRENT) OR DC (DIRECT CURRENT). THE POWER DEMAND USING DC IS LOWER, BEING INVERSELY PROPORTIONAL TO THE A.C. POWER FACTOR ANGLE OF THE EQUIPMENT. THE NEGATIVE ELECTRODE DOES NOT ERODE AS FAST ON DC AND MAY BE ADVANTAGEOUS IN MAKING CLASS I WELDS. IN THE DEVELOPMENT OF RESISTANCE WELDING SCHEDULES THE FOLLOWING POINTS WERE OBSERVED: WELDING FORCES TO BE KEPT WITHIN CAPABILITY OF PRESENT EQUIPMENT, SURFACE IN DENTATION NOT TO EXCEED 14% OF SHEET THICKNESS, SHEET SEPARATION NOT TO EXCEED 10% OF THICKNESS OF THINNEST SHEET, MINIMUM CURRENT RANGE OF 15% REQUIRED, AND "WELD RELIABILITY TEST" TO BE PASSED.

by W. DILAY; E. A. ROGALA; E. J. ZULINSKI  
FORD MOTOR CO.

Rept. No. SAE-770305; 1977; 11P  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 196

**APPLICATION OF ALUMINUM IN BODY WEIGHT REDUCTION**

A GENERAL REVIEW OF THE SUCCESSFUL CONVERSION FROM STEEL TO ALUMINUM IN THE CONSTRUCTION OF LOAD FLOORS ON CERTAIN 1977 MODEL YEAR CARS (PINTO, BOBCAT, AND MERCURY STATION WAGONS) IN AN EFFORT TO MEET WEIGHT REDUCTION GOALS IS PRESENTED. ALUMINUM WAS SELECTED BECAUSE CONVERSION TO THIS MATERIAL HAS A MINIMAL EFFECT ON EXISTING FACILITIES AND ONE OF THE OBJECTIVES WAS TO GO WITH A DUAL PROGRAM OF ALUMINUM AND STEEL LOAD FLOORS, MADE FROM COMMON TOOLS. THE FUNCTION OF DIFFERENT LOAD FLOOR (WHICH SUPPORT THE SECOND SEAT FOLD-DOWN SEAT BACK AND ACT AS THE FLOOR OF THE LUGGAGE AREA BEHIND THE SECOND SEAT) COMPONENTS FOR THE VARIOUS VEHICLES IS OUTLINED; THE DESIGN ANALYSIS FOR BENDING STRENGTH, BENDING STIFFNESS, AND DENT RESISTANCE IS EVALUATED; TEST RESULTS OF ALUMINUM AND STEEL PARTS ARE COMPARED; AND MANUFACTURING CONSIDERATIONS AND DIFFERENT JOINING METHODS ARE DISCUSSED. WITH MINOR CHANGES IN FORMING DIES AND WELDING EQUIPMENT, THE GOAL TO MAKE ALUMINUM AND STEEL PARTS FROM COMMON TOOLS WAS ACHIEVED. THIS PROJECT WAS

SUCCESSFULLY IMPLEMENTED AS A RESULT OF EARLIER WORK DONE BY THE ADVANCED BODY ENGINEERING. IT IS ANTICIPATED THAT INCREASED NUMBER OF BODY PANELS WILL USE ALUMINUM AS MORE AND MORE EMPHASIS IS PLACED ON WEIGHT REDUCTION.

by M. B. MOTWANI  
FORD MOTOR CO.

Rept. No. SAE-770306; 1977; 8P 6REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION, DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 197

### CONTRIBUTIONS TO THE BOLTZMANN-LIKE APPROACH FOR TRAFFIC FLOW--A MODEL FOR CONCENTRATION DEPENDENT DRIVING PROGRAMS

BOLTZMANN-LIKE THEORIES FOR TRAFFIC FLOW ARE CONSIDERED. FIRST, A CRITICAL REVIEW OF THE WORK OF PRIGOGINE ET AL. (1960, 1971) IS PRESENTED IN ORDER TO ELIMINATE SOME AMBIGUITY IN THE MEANING OF THE RELAXATION TERM, THE DESIRED SPEED, AND THE DESIRED SPEED DISTRIBUTION FUNCTION. NEXT, THE CASE OF "RIGID" DRIVING PROGRAM (I.E. INDEPENDENT OF THE CONCENTRATION) IS ANALYZED; IN PARTICULAR, THE HOMOGENEOUS AND TIME-INDEPENDENT EQUATIONS ARE SHOWN TO BE SOLVABLE AND THE SOLUTIONS ARE COMPARED WITH THOSE OBTAINED BY PRIGOGINE ET AL. (1971). THE GENERAL CASE OF A CONCENTRATION DRIVING PROGRAM IS THEN CONSIDERED AND THE RELATED EQUATIONS ARE OBTAINED. UNDER THE SIMPLIFYING ASSUMPTION OF "UNIFORM ADAPTABILITY," THE HOMOGENEOUS AND STATIONARY SOLUTIONS ARE SHOWN TO BE APPROXIMATED BY THE "SHIFT MODEL" PROPOSED BY MUNJAL ET AL. (1971).

by E. ALBERTI; G. BELLÌ  
Publ: TRANSPORTATION RESEARCH V12 N1 P33-42 (FEB 1978)  
1978; 7REFS  
SPONSORED BY [ITALIAN] NATIONAL RES. COUNCIL, COM. FOR MATHEMATICAL SCIENCES.  
Availability: SEE PUBLICATION

HS-023 198

### A SIMULATION ANALYSIS OF PEDESTRIAN ACTUATED TRAFFIC SIGNAL CONTROL SYSTEM

TO AID IN THE DESIGN AND EVALUATION OF PEDESTRIAN-ACTUATED TRAFFIC SIGNAL CONTROL SYSTEMS, A SIMULATION MODEL IS USED ALONG WITH THEORETICAL CONSIDERATIONS TO DEVELOP A SET OF EQUATIONS WHICH DEPICT THE PERFORMANCE OF THE SYSTEM IN TERMS OF FREQUENCY OF PEDESTRIAN INTERFERENCE, TRAFFIC DELAY, AND QUEUE LENGTH. THE EQUATIONS MAY BE USEFUL IN IDENTIFYING OPTIMAL SETTINGS OF SUCH SYSTEMS. GENERALLY SPEAKING, PEDESTRIAN-ACTUATED SYSTEMS ARE CAPABLE OF

PROCESSING TRAFFIC FLOW WITH LESS DELAY THAN PRETIMED SYSTEMS AT ISOLATED INTERSECTIONS. THIS, HOWEVER, DOES NOT IMPLY THE SAME IS TRUE AT INTERACTING INTERSECTIONS. TO MINIMIZE THE OVERALL AVERAGE PEDESTRIAN AND VEHICLE DELAY AT AN INTERSECTION, PEDESTRIAN GREEN DURATION SHOULD BE SET EQUAL TO THE MINIMUM TIME REQUIRED FOR WAITING PEDESTRIANS TO CROSS THE INTERSECTION. FURTHERMORE, A SMALL MINIMUM VEHICLE GREEN DURATION SHOULD BE USED WHEN THE PEDESTRIAN OR VEHICLE FLOW IS LIGHT, AND A LARGE DURATION WOULD BE NEEDED FOR A COMBINATION OF HEAVY PEDESTRIAN AND VEHICULAR FLOWS. THE CURRENT WORK CAN BE EXTENDED IN SEVERAL RESPECTS. FIRST, THE EQUATIONS CAN BE EMPLOYED TO DEVELOP GUIDELINES FOR INTERSECTION CONTROL AND FOR CHOICE BETWEEN PRETIMED AND PEDESTRIAN ACTUATED SYSTEMS. SECOND, OPTIMAL CONTROL STRATEGIES WITH RESPECT TO VARIOUS OBJECTIVE FUNCTIONS AND CONSTRAINTS CAN BE DERIVED FROM THE SAME EQUATIONS AND BE PUT INTO A FORM SUITABLE FOR PRACTICING ENGINEERS. FINALLY, JUDGING FROM THE WIDE USE OF PEDESTRIAN-ACTUATED CONTROL SYSTEMS IN SMALL URBAN AREAS, IT IS ESSENTIAL THAT THE DESIRABILITY OF USING SUCH SYSTEMS FOR CONTROLS AT INTERACTING INTERSECTIONS BE SUBJECT TO FURTHER QUANTITATIVE ANALYSES.

by FENG-BOR LIN  
Publ: TRANSPORTATION RESEARCH V12 N1 P21-8 (FEB 1978)  
1978; 9REFS  
Availability: SEE PUBLICATION

HS-023 199

### COMPARISON OF MEASURED AND FORECAST TRAFFIC VOLUMES ON URBAN INTERSTATE HIGHWAYS

FORECASTS OF 1975 AVERAGE DAILY TRAFFIC (ADT) ON 78 INTERSTATE HIGHWAY SEGMENTS IN 55 U.S. CITIES AND TOWNS WERE COMPARED WITH MEASUREMENTS OF 1975 ADT ON THE SAME SEGMENTS. THE FORECASTS WERE MADE IN 1968 AND 1972. IT WAS FOUND THAT THE 1968 AND 1972 FORECASTS TENDED TO OVERESTIMATE 1975 ADT BY 24% AND 21%, RESPECTIVELY. POSSIBLE SOURCES OF THIS FORECASTING BIAS INCLUDE THE RESIDUAL EFFECTS OF THE 1973-1974 GASOLINE SHORTAGE AND ERRORS IN TRAFFIC ASSIGNMENT TECHNIQUES. THERE IS A NEED FOR COMPARISONS OF TRAFFIC FORECASTS WITH SUBSEQUENT MEASUREMENTS OF TRAFFIC VOLUMES AND THE USE OF THE INFORMATION THUS OBTAINED TO IMPROVE FORECASTING TECHNIQUES. THE RELIABILITY OF TRAFFIC FORECASTS CANNOT BE TAKEN FOR GRANTED; EXTREME CAUTION SHOULD BE USED IN APPLYING SUCH FORECASTS TO THE DETERMINATION OF PUBLIC POLICY.

by JOEL HOROWITZ; ROBERT EMSLIE  
Publ: TRANSPORTATION RESEARCH V12 N1 P29-32 (FEB 1978)  
1978; 11REFS  
Availability: SEE PUBLICATION

HS-023 200

HS-023 200

### THE COMPLEMENTARY ROLES OF REGULATORY AND FISCAL METHODS OF TRAFFIC RESTRAINT

THE RELATIONSHIP BETWEEN REGULATORY AND FISCAL POLICIES OF TRAFFIC RESTRAINT IS EXPLORED BY APPLYING TRANSPORTATION PLANNING METHODS OF APPRAISAL. THE POLICY OF ROUTE RESTRICTION ON TRUCKS IN URBAN AREAS AND THE POLICY OF CHARGES FOR TRUCKS FOR ENTRY TO A GIVEN AREA ARE USED IN ILLUSTRATIVE ANALYSIS OF THE ENVIRONMENTAL AND COST BALANCE BETWEEN THE TWO TYPES OF POLICY. A PRACTICAL AND WORTHWHILE STEP TOWARD A COMPARABLE BASIS FOR REGULATORY MEASURES AND STRATEGIC PLANNING PROPOSALS TO ACHIEVE ENVIRONMENTAL IMPROVEMENT IS DELINEATED. IN PARTICULAR, A CLEAR LINK HAS BEEN FORGED BETWEEN ENVIRONMENTAL CHANGES AND THE ECONOMIC COSTS OF THE CONTROL USED. THE TECHNIQUES REQUIRED WERE UNTIL RECENTLY AVAILABLE ONLY AS RESEARCH TOOLS, AND THOSE USED FOR INVESTIGATION WOULD NOT BE SUITABLE FOR ROUTING APPLICATIONS IN VIEW OF THE SUBSTANTIAL DATA REQUIREMENTS. TRUCK ROUTES, NOT UNEXPECTEDLY, INCUR AN ECONOMIC COST, BUT THIS COST IS BALANCED TO SOME EXTENT BY AMELIORATION OF ENVIRONMENTAL NUISANCE. THE TWO TYPES OF RESTRAINT, REGULATORY AND FISCAL, ARE SHOWN TO PLAY COMPLEMENTARY ROLES IN THE ATTAINMENT OF ECONOMIC AND ENVIRONMENTAL GOALS; AND WHILE IT IS CLEAR THAT AN ECONOMIC LEVEL OF FISCAL RESTRAINT COULD CLEAR THE WAY FOR ENVIRONMENTAL PROTECTION REGULATIONS, REGULATIONS ALONE ARE NOT NECESSARILY VERY EFFECTIVE IN ENVIRONMENTAL TERMS AND COST SOCIETY REAL RESOURCES. ONLY WHEN AN ECONOMIC BALANCE HAS BEEN STRUCK COULD THE ENVIRONMENTAL GAINS BE MAXIMIZED WHILE MINIMIZING THE NET COST OF REGULATORY MEASURES.

by M. R. WIGAN  
Publ: TRANSPORTATION RESEARCH V12 N1 P55-63 (FEB 1978)  
1978; 11REFS  
Availability: SEE PUBLICATION

HS-023 201

### THE ESTIMATION OF SATURATION FLOW, EFFECTIVE GREEN TIME AND PASSENGER CAR EQUIVALENTS AT TRAFFIC SIGNALS BY MULTIPLE LINEAR REGRESSION

THE ESTIMATED TIMES OF THE BEGINNING AND END OF THE EFFECTIVE GREEN PERIOD FOR AN APPROACH ARE DEPENDENT ON THE METHOD USED TO ESTIMATE STARTING DELAYS AND THE AMOUNT OF AMBER TIME THAT IS EFFECTIVELY GREEN. "SYNCHRONOUS" METHODS WHICH TERMINATE OBSERVATION AT THE INSTANT OF A VEHICLE DEPARTURE WILL PRODUCE ESTIMATES OF THESE TWO QUANTITIES WHICH ARE  $1/(2S')$ , WHERE  $S'$  IS THE ESTIMATED SATURATION FLOW IN VEHICLES/UNIT

HSL 78-11

TIME, SHORTER THAN ESTIMATES PRODUCED BY "ASYNCHRONOUS" METHODS WHICH TERMINATE OBSERVATIONS AT AN ARBITRARY POINT IN TIME. THIS MEANS THAT ASYNCHRONOUS METHODS ESTIMATE THE EFFECTIVE GREEN PERIOD TO OCCUR  $1/(2S')$  LATER THAN DO SYNCHRONOUS METHODS, WITHOUT THE MAGNITUDE OF THE EFFECTIVE GREEN TIME BEING AFFECTED. THE SYNCHRONOUS AND ASYNCHRONOUS METHODS ARE APPLIED TO DATA FROM A SIMPLE SITE, AND TWO SOURCES OF BIAS (LENGTH OF FIRST COUNTING PERIOD AND LENGTH OF LAST COUNTING PERIOD) ARE IDENTIFIED IN THE DATA FOR THE SYNCHRONOUS METHOD. WHEN THE DATA FOR THE SYNCHRONOUS METHOD ARE MODIFIED TO ELIMINATE THESE BIASES, THE PARAMETER ESTIMATES FROM THE TWO METHODS ARE FOUND TO BE CONSISTENT WITH ONE ANOTHER AND WITH VALUES REPORTED ELSEWHERE. DATA COLLECTION IS PARTICULARLY STRAIGHTFORWARD WITH EITHER METHOD, AS IT REQUIRES ONLY COUNTS AND TIMINGS TO BE RECORDED. THIS EASE OF DATA COLLECTION RELATIVE TO THE NUMBER OF PARAMETERS ESTIMATED BY THE REGRESSION METHODS IS PERHAPS THEIR MAIN ADVANTAGE OVER TRADITIONAL METHODS.

by DAVID BRANSTON; HENK VAN ZUYLEN  
Publ: TRANSPORTATION RESEARCH V12 N1 P47-53 (FEB 1978)  
1978; 14REFS  
SPONSORED IN PART BY THE SCIENCE RES. COUNCIL (ENGLAND?).  
Availability: SEE PUBLICATION

HS-023 202

### DEGRADATION OF STEERING AND SUSPENSION COMPONENTS AFFECTING DRIVER-VEHICLE PERFORMANCE DURING EMERGENCY SITUATIONS

THE EFFECTS OF FREE PLAY IN STEERING AND WHEEL SUSPENSION COMPONENTS ON VEHICLE HANDLING, WITH SPECIAL ATTENTION TO THE PERFORMANCE OF THE DRIVER/VEHICLE SYSTEM IN EMERGENCY SITUATIONS, WERE INVESTIGATED. A FIELD STUDY WAS CONDUCTED IN WHICH 33 SUBJECTS DROVE A VOLVO 142 AND A SAAB 99 IN BOTH ORIGINAL CONDITION AND WITH CERTAIN DEGRADATIONS IN STEERING AND WHEEL SUSPENSION. THE CARS WERE DRIVEN ON A TEST TRACK WHERE THE DRIVERS WERE EXPOSED TO TWO DIFFERENT TYPES OF SITUATIONS IN WHICH QUICK AVOIDANCE MANEUVERS WERE NECESSARY, ONE WHERE THE DRIVER WAS PREPARED TO SOME EXTENT AND THE OTHER WHERE THE DRIVER WAS COMPLETELY UNPREPARED. THE CARS WERE EQUIPPED WITH INSTRUMENTS FOR MEASURING SPEED, LATERAL ACCELERATION, AND STEERING WHEEL MOVEMENTS; ALSO MEASURED WERE THE NUMBER OF LANE MARKING CONES HIT AND WHETHER A SUDDENLY APPEARING OBSTACLE WAS RUN OVER OR NOT. AFTER HAVING DRIVEN THE VEHICLES, THE DRIVERS MADE A COMPARATIVE RATING OF THE HANDLING QUALITIES OF THE CARS. THE RESULTS SHOWED THAT THE DRIVING PRECISION WAS ALMOST EXACTLY THE SAME WITH

HE DEFECTIVE VEHICLES AS WITH THE ORIGINAL NEX, AND THE RECORDED VALUES DID NOT SHOW ANY GREATER RISK FOR LOSING CONTROL OF THE EFFECTIVE CARS. HOWEVER, THE DEFECTIVE VEHICLES REQUIRED MORE STEERING ACTIVITY FROM HE DRIVERS. THE DRIVER WAS ABLE TO COMPENSATE FOR THE DEGRADATIONS IN STEERING AND HEEL SUSPENSION IN ALL OF THE DRIVING ASKS. THE INVESTIGATIONS CONDUCTED SO FAR INDICATE THAT FREE PLAY IN STEERING AND HEEL SUSPENSION COMPONENTS DOES NOT AFFECT THE HANDLING CHARACTERISTICS OF THE EHICLE TO SUCH AN EXTENT THAT IT CAN BE REARDED AS UNSAFE IN TRAFFIC. HOWEVER, ENERALLY APPLICABLE LIMIT VALUES FOR FREE LAY IN STEERING AND WHEEL SUSPENSION COM- MONENTS CANNOT BE GIVEN ON THE BASIS OF IM- AIRED HANDLING CHARACTERISTICS ALONE; THE LIMIT VALUES SHOULD BE BASED MAINLY UPON HE RISK OF COMPONENT FAILURE (E.G. SEPARATED BALL JOINTS), AND UPON ECONOMIC CONSIDERATIONS (E.G. IF FREE PLAY IN TIE-ROD ENDS CAUSES INCREASED WEAR OF TIRES).

by PETER W. ARNBERG; OLLE ODSSELL  
STATENS VAG- OCH TRAFIKINSTITUT (VTI), 58101  
INKOPING, SWEDEN  
Rept. No. VTI-109A; 1978; 35P 9REFS  
Availability: CORPORATE AUTHOR

IS-023 203

#### THE ABILITY OF PRESCHOOL- AND SCHOOLCHILDREN TO MANOEUVRE [MANEUVER] THEIR BICYCLES

N ORDER TO DETERMINE WHICH FACTORS ARE IMPORTANT IN A CHILD'S ABILITY TO RIDE A BICYCLE, AN EXPERIMENT WITH 144 CHILDREN BETWEEN THE AGES OF 5 AND 13 WAS CARRIED OUT IN WHICH SKILLS IN MANEUVERING, ACCELERATING, AND BRAKING WERE TESTED. THIS STUDY IS ONE OF A SERIES AIMED AT PROVIDING A BASIS FOR IMPROVING TRAFFIC SAFETY FOR CHILDREN. THE TESTS, CONDUCTED AT NINE SEPARATE SITES, WERE INTENDED TO MEASURE BEHAVIOR WHICH ACTUALLY TAKES PLACE IN TRAFFIC SITUATIONS, E.G. THE ABILITY TO LOOK BACKWARDS WHILE CYCLING. AFTER THE TESTS WERE COMPLETED, EACH CHILD WAS INTERVIEWED ABOUT HIS/HER CYCLING HABITS, ATTITUDES, AND ANY ACCIDENTS HE/SHE MAY HAVE HAD. THE RESULTS SHOWED THAT THE AGE OF THE CHILDREN WAS THE MOST IMPORTANT FACTOR IN DETERMINING THEIR CYCLING ABILITY. THE FREQUENCY OF THEIR CYCLING AND THE DESIGN OF THEIR BICYCLES WERE ALSO VERY IMPORTANT. THE INTERVIEWS SHOWED THAT MOST OF THE CHILDREN STARTED TO RIDE A BICYCLE AT THE AGE OF 4 TO 5 AND THAT THEY WERE USING THEIR BICYCLES DAILY. DESPITE THIS, ONLY THE 13-YEAR-OLDS COULD MANAGE ALL OF THE TESTS WELL. THE CHILDREN UNDER AGE 8 PERFORMED VERY POORLY IN MOST OF THE TESTS, AND IT IS THEREFORE DOUBTFUL IF THESE CHILDREN SHOULD BE ALLOWED TO CYCLE IN TRAFFIC AT ALL. THE CHILDREN BETWEEN THE AGES OF 8 AND 12 PERFORMED SIGNIFICANTLY BETTER, ESPE-

CIALLY THOSE WHO CYCLED MOST FREQUENTLY. HOWEVER, IT SHOULD BE STRESSED THAT THIS INVESTIGATION DID NOT STUDY HOW EARLY CHILDREN MIGHT BE ABLE TO RIDE A BICYCLE SATISFACTORILY GIVEN PROPER TRAINING AND A BICYCLE MORE PROPERLY ADAPTED TO THEIR CAPABILITY. IT IS NECESSARY TO CONTINUE EXPERIMENTS IN WHICH THE DESIGN COMPONENTS AS WELL AS THE EFFECTS OF DIFFERENT LEARNING METHODS ARE STUDIED IN ORDER TO FURTHER CLARIFY THE RELATIONSHIP BETWEEN PERFORMANCE AND DEVELOPMENT OF THE CHILD.

by PETER W. ARNBERG; EVERET OHLSSON; ANNELI WESTERBERG; CARL-ADOLF OSTROM  
STATENS VAG- OCH TRAFIKINSTITUT (VTI), 58101  
LINKOPING, SWEDEN  
Rept. No. VTI-149A; 1978; 48P 6REFS  
SPONSORED BY NATIONAL BOARD FOR CONSUMER POLICIES AND THE NATIONAL ROAD AND TRAFFIC RES. INST. (SWEDEN).  
Availability: CORPORATE AUTHOR

HS-023 204

#### STATISTICS WITH APPLICATIONS TO HIGHWAY TRAFFIC ANALYSES. REV. ED.

MUCH OF THE TEXT AND STATISTICAL FORMULATION IN THE ORIGINAL MONOGRAPH (1952) WERE RETAINED INTACT IN THIS EDITION; IT WAS EXPANDED TO INCLUDE NEWER METHODS, SUCH AS COMPUTER PROCESSING, AND APPLICATIONS TO MORE CURRENT TRANSPORTATION PROBLEMS. MOREOVER, EXTENSIVE USE OF THE ORIGINAL EDITION AS A TEXT FOR TRANSPORTATION ENGINEERING COURSES IN COLLEGES AND UNIVERSITIES HAD INDICATED NEED FOR REORGANIZATION OF THE SUBJECT MATTER TO CONFORM TO TEACHING OUTLINES. THE FIVE CHAPTERS COVER THE FOLLOWING TOPICS: THE NATURE AND UTILITY OF STATISTICS, SUMMARIZING DATA, PROBABILITY AND PROBABILITY DISTRIBUTIONS, FUNDAMENTALS OF STATISTICAL INFERENCE, AND SOME APPLICATIONS OF STATISTICAL METHODS (TO PROBLEMS OF MOST INTEREST TO TRAFFIC ENGINEERS).

by BRUCE DOUGLAS GREENSHIELDS; FRANK MARK WEIDA  
1978; 196P 9REFS  
REVISED BY DANIEL L. GERLOUGH AND MATTHEW J. HUBER.  
Availability: ENO FOUNDATION FOR TRANSPORTATION, INC., BOX 55, SAUGATUCK STATION, WESTPORT, CONN. 06880

HS-023 205

#### FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE. PROCEEDINGS OF THE SYMPOSIUM, GENERAL MOTORS RESEARCH LABORATORIES, OCTOBER 6-7, 1975

THIS COMPILATION OF PAPERS IS ARRANGED BY THE FOLLOWING CATEGORIES: THE NEED, RESOURCES, AND POSSIBILITIES; FUTURE AUTOMOTIVE FUEL SOURCES; AUTOMOTIVE UTILIZATION OF

HS-023 206

HSL 78-1

INTERMEDIATE-TERM FUTURE FUELS; AND LONG-TERM FUELS AND AN OVERALL ASSESSMENT. THE FIRST SESSION CONSIDERED THE FUTURE DEMAND FOR AUTOMOTIVE FUELS, THE U.S. ENERGY OUTLOOK THROUGH 1990, ENERGY CONSERVATION AND FUEL/VEHICLE OPTIMIZATION, MAXIMIZING TRANSPORTATION ENERGY CONSERVATION, AND MATCHING FUTURE AUTOMOTIVE FUELS AND ENGINES FOR OPTIMUM ENERGY EFFICIENCY. THE SECOND SESSION CONSIDERED COAL, OIL SHALE, AND NUCLEAR ENERGY AS SOURCES OF FUTURE AUTOMOTIVE FUELS. THE THIRD SESSION DEALT WITH THE CHARACTERISTICS OF CONVENTIONAL FUELS FROM NONPETROLEUM SOURCES, A NEW COMBUSTION ANALYSIS METHOD, ENGINE PERFORMANCE AND EXHAUST EMISSION OF A METHANOL-FUELED AUTOMOBILE, METHANOL COMBUSTION IN AN AUTOMOTIVE GAS TURBINE, AND ALTERNATIVE FUELS FOR AUTOMOTIVE DIESEL ENGINES. THE FOURTH SESSION DEALT WITH HYDROGEN AS A RECIPROCATING ENGINE FUEL, HYDRONITROGENS AS FUTURE AUTOMOTIVE FUELS, AND IMPACTS OF SYNTHETIC LIQUID FUEL DEVELOPMENT FOR THE AUTOMOTIVE MARKET. DISCUSSIONS FOLLOW EACH PAPER, AND SUMMARIES OF EACH CATEGORY (EXCEPT THE LAST) ARE PROVIDED. A LIST OF PARTICIPANTS AND A SUBJECT INDEX ARE ALSO INCLUDED.

by JOSEPH M. COLUCCI, ED.; NICHOLAS E. GALLOPOULOS, ED.  
GENERAL MOTORS RES. LABS., WARREN, MICH.  
1977; 385P 19REFS  
INCLUDES HS-023 206--HS-023 221.  
Availability: PLENUM PRESS, 227 W. 17TH ST., NEW YORK, N.Y. 10011

HS-023 206

#### FUTURE DEMAND FOR AUTOMOTIVE FUELS

A BASELINE FORECAST OF AUTOMOTIVE FUEL DEMAND THROUGH 1990 IS PROVIDED. NO DISTINCTION IS MADE REGARDING THE NATURE OF THIS FUEL (GASOLINE, DIESEL FUEL, NO LEAD, OCTANE RATING, ETC.) SINCE THE ANALYSIS DOES NOT SPECIFY OR EVALUATE ENGINE TECHNOLOGIES. THE BASELINE FORECAST IS DEVELOPED FROM A MULTI-EQUATION MODEL WHICH EXPLICITLY CONSIDERS THE FUEL EFFICIENCY OF NEW CARS, THE SALES AND MARKET SHARES OF NEW CARS, USED CAR SCRAPPAGE, AND VEHICLE MILES TRAVELED. THE FACTORS WHICH AFFECT THE DEMAND FOR AUTOMOBILES, THE CHARACTERISTICS OF AUTOMOBILES DEMANDED, AND THE DEMAND FOR TRAVEL ARE DISCUSSED. A BRIEF MODEL DOCUMENTATION IS PROVIDED. USING FORECASTS OF INPUT VARIABLES WHICH REFLECT NORMAL ECONOMIC GROWTH EXPECTATIONS AND RELATIVELY STABLE FUEL PRICES, HIGHWAY TRAVEL AND FUEL CONSUMPTION INCREASE SUBSTANTIALLY THROUGH THE YEAR 2000. UNDER THE DECREASING FUEL PRICE ASSUMPTION, AUTO FUEL CONSUMPTION INCREASES 85% OVER 1976 LEVELS BY THE YEAR 2000. UNDER THE INCREASING FUEL PRICE ASSUMPTION, THIS GROWTH IS REDUCED TO 40% FOR THE SAME PERIOD. THESE FORECASTS COULD BE REDUCED SUBSTANTIALLY IF MORE FUEL EFFICIENT AUTO

SUPPLY SCENARIOS WERE INTRODUCED. THE ASSUMPTIONS USED WERE THE MOST CONSERVATIVE GIVEN TECHNOLOGICAL ADVANCES IN ENGINE AND CHASSIS DESIGN, SUBSTANTIALLY LOWER FUEL CONSUMPTION CAN BE EXPECTED.

by R. F. HEMPHILL, JR.; C. DIFIGLIO  
FEDERAL ENERGY ADMINISTRATION, WASHINGTON D.C.

Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P3-33

1977; 19REFS

PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.  
Availability: IN HS-023 205

HS-023 207

#### THE U.S. ENERGY OUTLOOK THROUGH 1990

DRAWING UPON INDEPENDENT SOCIAL/POLITICAL/ECONOMIC STUDIES, THE U.S. ENERGY OUTLOOK THROUGH THE YEAR 1990 ESTIMATED AND GIVEN IN TERMS OF TOTAL ENERGY DEMAND BY MARKET SECTOR (EXPORT, CONVERSION (FROM ONE FUEL TO ANOTHER) LOSSES, RESIDENTIAL/ COMMERCIAL, CHEMICAL FEED STOCK, INDUSTRIAL, TRANSPORTATION, GENERATION AND TRANSMISSION OF ELECTRICITY) AND TOTAL ENERGY SUPPLY BY PRIMARY FUEL (SOLAR, HYDROTHERMAL AND GEOTHERMAL, NUCLEAR, COAL, GAS, OIL). ONE IMPORTANT FINDING IS THAT IN SPITE OF A DECREASE IN THE RATE OF GROWTH OF TOTAL ENERGY DEMAND, BY 1990 AN ADDITIONAL 19 MILLION BARRELS/DAY OF EQUIVALENTS WILL BE REQUIRED. HALF OF THIS NEW DEMAND WILL BE MET WITH NUCLEAR POWER, WHILE COAL AND OIL WILL PROVIDE MOST OF THE REMAINDER. WHILE THE DOMESTIC SUPPLIES (INCLUDING ARCTIC) OF ALL FUELS EXCEPT NATURAL GAS INCREASE, THE SUPPLY/ DEMAND GAP CONTINUES TO GROW THROUGH 1985 AND CAN ONLY BE MET BY INCREASING OIL IMPORTS. A FURTHER ANALYSIS OF THE TRANSPORTATION SECTOR BY SPECIFIC OIL PRODUCTS (FUELS) AND BY MODE (E.G. CARS, TRUCKS, AIRCRAFT, ETC.) SHOWS THAT TRANSPORTATION FUEL DEMAND, WHICH HAS BEEN GROWING AT A RATE OF NEARLY 5% PER YEAR IN THE RECENT PAST, WILL DECLINE TO ABOUT 1% PER YEAR OVER THE FORECAST PERIOD. MUCH OF THIS DECLINE WILL BE THE RESULT OF A REDUCED DEMAND FOR PASSENGER CAR MOTOR GASOLINE. THE U.S. CAPABILITY TO ATTENUATE DEMAND THROUGH CONVENTIONAL CONSERVATION MEASURES IS INSUFFICIENT TO COUNTERBALANCE DOMESTIC SUPPLY DEFICIENCIES. FURTHER, TO EFFECT A SUBSTANTIAL DECREASE IN OIL IMPORTS BEFORE 1985 WOULD REQUIRE A NATIONAL PROGRAM THAT WOULD IMPACT IN A

**MAJOR WAY UPON U.S. PATTERNS OF CONSUMER USE AND LIFESTYLE.**

by S. J. BEAUBIEN  
SHELL OIL CO., HOUSTON, TEX.

Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P34-58

1977

PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.

Availability: IN HS-023 205

HS-023 208

**ENERGY CONSERVATION AND FUEL-VEHICLE OPTIMIZATION**

RESEARCH CONDUCTED TO DEFINE THE RELATIONSHIPS AMONG OCTANE LEVELS, COMPRESSION RATIO, AND FUEL ECONOMY AND A STUDY OF PROCESS ENERGY CONSERVATION AS INCREASING VOLUMES OF AUTOMOTIVE DISTILLATE (VS. GASOLINE) ARE MADE, ARE REVIEWED. IT WAS FOUND THAT INCREASING COMPRESSION RATIO AND UNLEADED GASOLINE OCTANE CAN IMPROVE AUTOMOBILE FUEL ECONOMY, BUT THERE IS A PARTIALLY OFFSETTING INCREASE IN REFINERY ENERGY CONSUMPTION. BASED ON STUDY OF ONE HYPOTHETICAL AND THREE ACTUAL REFINERIES, POSSIBLE NET CRUDE OIL SAVINGS VARY BETWEEN 1% AND 3% OF GASOLINE CONSUMPTION. HOWEVER, CONSIDERING THE HIGH COST AND LOW VOLUME OF CRUDE OIL GENERATED, AND THE SIGNIFICANT UNCERTAINTIES INVOLVED, INCREASING COMPRESSION RATIO IS NOT ECONOMICALLY ATTRACTIVE RELATIVE TO THE CURRENT PRICES OF EITHER IMPORTED OR NEW DOMESTIC CRUDE OIL. IT IS SUGGESTED THAT SOME OF THE CHANGES MADE AS PART OF ENGINE MODIFICATION FOR EXHAUST EMISSION CONTROL BE REEXAMINED. THE GASOLINE/DISTILLATE RATIO STUDY INDICATES A 2% SAVINGS IN CRUDE DUE TO REDUCED PROCESS ENERGY REQUIREMENTS AT A 1:1 RATIO OF AUTO DISTILLATE TO GASOLINE. IN HIGHLIGHTING THIS ENERGY SAVINGS, IT SHOULD NOT BE ASSUMED THAT AUTO DISTILLATE VOLUME WILL GROW TO THAT OF GASOLINE. WITH RESPECT TO THE POTENTIAL GROWTH OF AUTO DISTILLATE, THE RATIO OF GASOLINE TO AUTO DISTILLATE IS NOW 10:1 ON A BTU BASIS, AND IT COULD CHANGE IN A FUTURE GRASS-ROOTS REFINERY TO 1:1 BUT MORE REALISTICALLY IT COULD BE 5:1 OR 6:1 BY 1990.

by H. G. SHANNON  
EXXON RES. AND ENGINEERING CO., LINDEN, N.J.  
Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P59-72

1977; 3REFS

PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.

Availability: IN HS-023 205

HS-023 209

**AN OPPORTUNITY FOR MAXIMIZING TRANSPORTATION ENERGY CONSERVATION**

ENGINE-FUEL COMBINATIONS CONSIDERED INCLUDE GASOLINE ENGINES USING LEADED AND UNLEADED FUELS, DIESEL ENGINES, AND FUTURE GAS TURBINES. ADDITIONALLY EXAMINED WAS AN ENGINE PROVIDING THE FUEL ECONOMY OF THE DIESEL, HAVING NO OCTANE OR CETANE REQUIREMENT, AND OPERATING ON A 100°-650° F BROAD BOILING RANGE FUEL; SUCH AN ENGINE WAS REPRESENTED BY THE DIRECT INJECTION STRATIFIED CHARGE (DISC) ENGINE. IT WAS CONCLUDED THAT MAXIMUM TRANSPORTATION PER BARREL OF CRUDE OIL IS REQUIRED TO SUPPORT THE U.S. ECONOMY UNDER CONDITIONS OF DECLINING CRUDE SUPPLIES AND INCREASING COSTS OF CRUDE OIL. A DISC ENGINE, AS DESCRIBED, PROVIDES THE MAXIMUM TRANSPORTATION IN TERMS OF MILES PER BARREL OF CRUDE OIL AND MINIMUM REFINERY ENERGY LOSSES FOR THE CASES STUDIED. AN INTERNAL COMBUSTION ENGINE THAT REQUIRES UNLEADED GASOLINE PROVIDES THE LEAST TRANSPORTATION PER BARREL OF CRUDE OIL. REQUIREMENTS FOR IMPORTED CRUDE OIL CAN BE REDUCED APPRECIABLY BY USE OF DISC ENGINES IN MOTOR VEHICLES.

by E. M. JOHNSON; W. T. TIERNEY; N. R. CRAWFORD  
TEXACO, INC., BEACON, N.Y.

Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P73-95

1977; 22REFS

PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.

Availability: IN HS-023 205

HS-023 210

**MATCHING FUTURE AUTOMOTIVE FUELS AND ENGINES FOR OPTIMUM ENERGY EFFICIENCY**

IN THE INTEREST OF ENERGY SELF-SUFFICIENCY AND CONSERVATION OF ENERGY RESOURCES, A RATIONALE WAS DEVELOPED TO AID IN IDENTIFYING FUEL/ENGINE COMBINATIONS THAT MIGHT MINIMIZE ENERGY CONSUMPTION BY AUTOMOBILES IN THE FUTURE. COMBINED ENERGY EFFICIENCY WAS CHOSEN AS THE BASIS FOR APPRAISING POTENTIAL FUEL/ENGINE COMBINATIONS. COMBINED ENERGY EFFICIENCY IS A COMPOSITE OF THE EFFICIENCY OF PRODUCING AN ALTERNATIVE FUEL FROM AN ENERGY SOURCE AND THE EFFICIENCY WITH WHICH THAT FUEL CAN BE USED IN CARS POWERED BY ALTERNATIVE ENGINES. THE FUELS LIKELY TO BE PRODUCED FROM AVAILABLE ENERGY RESOURCES WERE IDENTIFIED AS FOLLOWS: FROM PETROLEUM - CLEANED CRUDE OIL, DISTILLATE FUEL, AND GASOLINE AND DIESEL FUELS; FROM OIL SHALE - HYDROGENATED SHALE OIL, DISTILLATE FUEL, AND GASOLINE AND DIESEL FUELS; FROM COAL - POWDERED COAL, PULVERIZED SOLVENT-REFINED COAL, SYNTHETIC OIL, DISTILLATE FUEL, GASOLINE AND DIESEL FUELS, METHANOL, AND FISCHER-TROPSCH LIQUIDS

(PARAFFINIC AND OLEFINIC HYDROCARBONS (HC); FROM BIOMASS - ETHANOL AND HC LIQUIDS; AND FROM NUCLEAR SOURCES - METHANOL AND HC LIQUIDS. ELECTRICITY CAN ALSO BE PRODUCED FROM EACH OF THE FIVE PRIMARY ENERGY SOURCES. EFFICIENCIES OF PRODUCING THE ABOVE FUELS WERE ESTIMATED UTILIZING INFORMATION IN THE LITERATURE AND THE AUTHORS' ENGINEERING JUDGMENT. DEPENDING ON THE SPECIFIC FUEL PRODUCED, THE FUEL-CONSERVATION EFFICIENCY ESTIMATES RANGE FROM 90%-98% FOR PETROLEUM-DERIVED FUELS, 63%-75% FOR OIL SHALE-DERIVED FUELS, 37%-95% FOR COAL-DERIVED FUELS, 25%-35% FOR FUELS FROM BIOMASS, AND 17%-20% FOR LIQUID FUELS FROM NUCLEAR SOURCES. ELECTRICITY, DEPENDING ON THE SOURCE, CAN PROBABLY BE PRODUCED AT 30%-39% EFFICIENCY. BECAUSE OF UNAVAILABILITY OF ALTERNATIVE FUELS AND THE LACK OF APPROPRIATE DATA FOR VEHICLES WITH ALTERNATIVE ENGINES, MEANINGFUL FUEL-UTILIZATION AND COMBINED ENERGY EFFICIENCY COMPARISONS WERE RESTRICTED TO CONVENTIONAL FUELS AND DIESEL AND SPARK IGNITION ENGINES. THE COMBINED ENERGY EFFICIENCIES FOR THOSE ENGINES OPERATED ON THEIR PETROLEUM-BASED FUELS WERE 15% AND 13%, RESPECTIVELY. IN CONCLUSION, TO APPLY THIS APPROACH TO ALL ALTERNATIVE FUELS AND ENGINES IN ORDER FIRMLY TO CONCLUDE WHICH COMBINATIONS ARE THE MOST ENERGY EFFICIENT, IMPROVEMENTS IN THE DATA BASES ARE REQUIRED. THE EFFICIENCIES OF CONVERTING ENERGY RESOURCES TO FUELS MUST BE ESTABLISHED WITH GREATER CERTAINTY THAN HERETOFORE POSSIBLE, THE PROPERTIES OF THE FUELS OBTAINED MUST BE DETERMINED, AND THE FUEL-UTILIZATION EFFICIENCY OF CARS POWERED WITH VARIOUS FUEL-ENGINE COMBINATIONS MUST BE MEASURED.

by R. F. STEBAR; W. A. DANIEL; A. R. SAPRE; B. D.

PETERS

GENERAL MOTORS RES. LABS., WARREN, MICH.

Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS.

PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P96-120

1977; 59REFS

PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.

Availability: IN HS-023 205

HS-023 211

### COAL AS A SOURCE OF AUTOMOTIVE FUELS

THE ENERGY RES. AND DEVEL. ADMINISTRATION (ERDA) FOSSIL ENERGY PROG. INCLUDES A MAJOR EFFORT TO PRODUCE TRANSPORTATION FUELS FROM COAL. COAL LIQUEFACTION PROJECTS CURRENTLY IN THE BENCH-SCALE AND PILOT PLANT STAGES ARE AIMED AT PRODUCING PRIMARY LIQUID PRODUCTS AT MAXIMUM THROUGHPUT AND MINIMUM COST. SAMPLES OF THESE PRODUCTS ARE CURRENTLY BEING SUPPLIED TO BENCH-SCALE REFINING UNITS FOR DETERMINING THE EFFEC-TIVENESS OF THE STATE-OF-THE-ART REFINERY PROCESSES TO PRODUCE SYNTHETIC CRUDE OILS AND SPECIFICATION TRANSPORTATION FUELS.

SINCE COAL-DERIVED LIQUIDS WILL BE SMALL VOLUME FOR SOME YEARS COMPARED TO THOSE FROM PETROLEUM, SYNTHETIC CRUDE OIL AMENABLE TO REFINERY PROCESSING WILL PROVIDE THE FIRST INTRODUCTION TO ACTUAL USE OF COAL-DERIVED AUTOMOTIVE FUELS. IN ADDITION AS LARGER QUANTITIES OF COAL-DERIVED LIQUIDS BECOME AVAILABLE IN 1977 AND 1978, REFINERY STUDIES NOW IN PROGRESS WILL PROVIDE TECHNIQUES FOR THE PREPARATION OF SIZES SAMPLES OF TRANSPORTATION FUELS FOR LARGE SCALE END-USE TESTING. COAL GASIFICATION PROJECTS NOW IN PROGRESS ARE EXPECTED TO LOWER THE COST OF PREPARING SYNTHESIS GAS FROM COAL. THIS WILL STIMULATE THE PRODUCTION OF MOTOR FUELS USING PROCESSES SIMILAR TO THOSE USED NOW TO PRODUCE MOTOR GASOLINE IN SOUTH AFRICA. IMPROVED CATALYSTS FOR SUCH PROCESSES ARE UNDER DEVELOPMENT. MANY TECHNICAL AND LOGISTIC PROBLEMS ARE STILL BEING SOLVED BEFORE COAL-DERIVED AUTOMOTIVE FUELS BECOME A REALITY. LARGE INCREASES IN COAL PRODUCTION WILL BE NECESSARY; THEIR IMPACT ON THE ECONOMY ARE UNDER STUDY. THE RATE OF PROCESS DEVELOPMENT AND NEW PLANT CONSTRUCTION AND DESIGN WILL DEPEND ON GOVERNMENTAL ACTION. THERE WILL BE DIFFERENCES BETWEEN PETROLEUM GASOLINES AND THOSE DERIVED FROM COAL. THE LATTER PROBABLY WILL HAVE HIGHER NITROGEN CONTENT AND GREATER AROMATICITY WITH ATTENDANT ENVIRONMENTAL PROBLEMS. SOLUTIONS TO THESE WILL REQUIRE CONTINUING COOPERATION BETWEEN ERDA AND THE AUTOMOTIVE INDUSTRY.

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### MOTOR FUELS FROM OIL SHALE--PRODUCTION AND PROPERTIES

THE CHARACTERISTICS OF THE OIL SHALES OF COLORADO, WYOMING, AND UTAH AND OF THE OIL DERIVED FROM THEM, THE PROCESSING OF THE SHALE AND THE DERIVED OIL, AND THE PROPERTIES OF THE FINISHED MOTOR FUELS PRODUCED FROM THE SHALE OIL ARE OUTLINED. THE WESTERN OIL SHALES ARE NOT SHALES AND DO NOT CONTAIN ANY LIQUID OIL. THE BASE MATERIAL IS A MARLSTONE, VERY SIMILAR TO LIMESTONE WHICH IS DENSE AND NONPOROUS. THE ORGANIC MATERIAL IS A SOLID CALLED KEROGEN WHICH DOES NOT MELT AND HAS VERY LIMITED SOLUBILITY IN SUCH ORGANIC SOLVENTS AS BENZENE, ACETONE, AND ETHER. IT IS NECESSARY TO HEAT THE KEROGEN TO TEMPERATURES NEAR 900° F TO CAUSE THE KEROGEN TO DECOMPOSE AND GIVE LIQUID SHALE OIL, GASES, AND CARBON.

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PRODUCTS. THE ORGANIC CONTENT OF THE WESTERN SHALES IS ABOUT 14% BY WEIGHT AND, UPON PYROLYSIS, YIELDS FROM 25 TO 40 GALLONS OF OIL PER TON OF ROCK. THERE ARE TWO GENERAL METHODS FOR CONVERTING THE SOLID KEROGEN TO SHALE OIL: ONE IS BY MINING AND RETORTING THE SHALE ABOVE GROUND, THE OTHER IS BY ESTABLISHING COMMUNICATIONS (INTRODUCING POROSITY) IN THE SHALE AND RETORTING THE SHALE UNDERGROUND OR IN SITU. THE RAW SHALE OIL PRODUCED FROM THE RETORTING IS HIGH IN UNSATURATED HYDROCARBONS, NITROGEN, AND SULFUR. IN ORDER TO PRODUCE SATISFACTORY MOTOR FUELS, MORE INTENSIVE AND EXPENSIVE PROCESSING IS REQUIRED THAN TO PRODUCE MOTOR FUELS FROM CONVENTIONAL CRUDE OILS. THE VISCOSITIES AND POUR POINTS ARE HIGHER THAN FOR MANY PETROLEUM CRUDE OILS OF SIMILAR GRAVITY. THIS MEANS THAT ADDITIONAL PROCESSING, SUCH AS VIS-BREAKING, CATALYTIC HYDROTREATING, OR HYDROCRACKING MUST BE PERFORMED AT OR NEAR THE RETORT SITE. IT IS ESTIMATED THAT A SHALE OIL INDUSTRY CAN BE ESTABLISHED WHICH CAN PRODUCE 1 TO 1.5 MILLION BARRELS PER DAY OF SHALE OIL. THIS IS FROM 5% TO 10% OF THE U.S. DAILY CONSUMPTION OF PETROLEUM. THE TECHNOLOGY IS AVAILABLE TO PRODUCE MOTOR FUELS MEETING EXISTING SPECIFICATIONS, BUT BECAUSE OF THE MORE SEVERE PROCESSING REQUIREMENTS, THE SYNTHETIC MOTOR FUELS WILL BE MORE COSTLY THAN TODAY'S PETROLEUM-BASED FUELS.

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HS-023 213

### THE INFLUENCE OF NUCLEAR ENERGY ON TRANSPORTATION FUELS

THE TERM "NUCLEAR ENERGY" COMMONLY EMBRACES FOUR TECHNOLOGIES: THERMAL FISSION REACTORS SUCH AS BOILING WATER REACTORS (BWR), PRESSURIZED WATER REACTORS (PWR), HIGH-TEMPERATURE GAS-COOLED REACTORS (HTGR); BREEDER REACTORS SUCH AS LIQUID METAL FAST BREEDER REACTORS (LMFBR) AND GAS COOLED FAST REACTORS (GCFR); FUSION REACTORS; AND NUCLEAR EXPLOSIVES. THESE TECHNOLOGIES POTENTIALLY PROVIDE ESSENTIALLY UNLIMITED SOURCES OF ENERGY FOR THE FUTURE; HOWEVER, WITH THE POSSIBLE EXCEPTION OF APPLICATION TO NUCLEAR SHIPS, THEY ARE NOT IN A FORM EASILY USED IN TRANSPORTATION. THE THERMAL FISSION REACTOR IS THE ONLY TECHNOLOGY NOW IN THE MARKETPLACE AS A COMMERCIAL ENERGY SOURCE. ABOUT 9% OF THE ELECTRICITY NOW BEING GENERATED IN THE U.S. COMES FROM THESE NUCLEAR PLANTS. THE BREEDER REACTOR, WITH HOPES OF COMMER-

CIALIZATION BEFORE THE END OF THE CENTURY, IS THE OBJECT OF A FEDERALLY-FINANCED TECHNOLOGY DEVELOPMENT PROGRAM. FUSION IS VERY PROMISING, BUT IT HAS YET TO BE DEMONSTRATED AS A TECHNICAL REALITY. HOWEVER, WITH RECENT DEVELOPMENTS THERE IS A POSSIBILITY OF A COMMERCIAL FUSION INDUSTRY EARLY IN THE NEXT CENTURY. THE ENERGY OF NUCLEAR EXPLOSIVES HAS BEEN SUGGESTED FOR MANY APPLICATIONS INCLUDING GAS AND OIL STIMULATION, GEOTHERMAL STIMULATION, AND SHALE RECOVERY. ONLY THE GAS STIMULATION CONCEPT HAS BEEN EXPRESSLY MENTIONED IN ENERGY RES. AND DEVEL. ADMINISTRATION (ERDA) DOCUMENTS. THE IDEA OF RELEASING LARGE NUMBERS OF NUCLEAR EXPLOSIVES UNDERGROUND HAS NOT YET BEEN ACCEPTED AS AN ATTRACTIVE ENERGY ALTERNATIVE. THE ONLY SIGNIFICANT NEAR-TERM INFLUENCE OF NUCLEAR ENERGY ON TRANSPORTATION FUELS IS DISPLACEMENT OF OIL FROM THE GENERATION OF ELECTRICITY SO THAT IT BECOMES AVAILABLE FOR OTHER USES. BY 1980, BETWEEN 15% AND 20% OF THE ELECTRICITY IN THE U.S. WILL BE GENERATED FROM NUCLEAR PLANTS COMPARED TO THE 9% TODAY. IN THE MID TERM (BEFORE THE YEAR 2000), NUCLEAR ENERGY MAY BE PROVIDING PROCESS HEAT TO COAL GASIFICATION AND LIQUEFACTION PLANTS. NUCLEAR HEAT MAY BE USED TO CRACK WATER INTO HYDROGEN AND OXYGEN TO PROVIDE FEEDSTOCKS FOR CHEMICAL AND SYNTHETIC FUEL INDUSTRIES. LIQUID HYDROGEN MAY BECOME THE FUEL FOR LARGE, LONG-RANGE AIR TRANSPORT. ALSO, NUCLEAR EXPLOSIVES MAY BE ACCEPTED AS A MEANS OF STIMULATING PRODUCTION OF OTHERWISE UNECONOMICAL NATURAL GAS FIELDS. AT SOME TIME IN THE FUTURE, FOSSIL FUELS FOR TRANSPORTATION WILL BECOME UNECONOMIC; NUCLEARLY PRODUCED HYDROGEN, AMMONIA, AND ELECTRICITY ARE ALL POTENTIALLY VIABLE ALTERNATIVES.

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### CHARACTERISTICS OF CONVENTIONAL FUELS FROM NON-PETROLEUM SOURCES--AN EXPERIMENTAL STUDY

EXPERIMENTAL DATA CONCERNING PHYSICAL PROPERTIES AND ENGINE PERFORMANCE CHARACTERISTICS ARE REPORTED FOR A GASOLINE DERIVED FROM OIL SHALE AND FOR A GASOLINE CONTAINING 44% OF A COAL-DERIVED MATERIAL. BOTH GASOLINES WERE USED SATISFACTORILY IN SHORT-TERM ENGINE TESTS. AS COMPARED WITH RESULTS OBSERVED USING A TYPICAL MID-CONTINENT PETROLEUM-DERIVED GASOLINE, THE CHANGE TO SYNTHETIC FUEL DID NOT SIGNIFI-

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CANTLY AFFECT EMISSIONS, FUEL ECONOMY, OR ENGINE PERFORMANCE. THE STABILITY OF THE SHALE GASOLINE WAS INADEQUATE FOR EXTENDED ENGINE TESTS. BUT THE DEFICIENCY IS JUDGED CORRECTABLE BY APPROPRIATE CHOICE OF AVAILABLE REFINING TECHNOLOGY AND/OR PROCESS ADJUSTMENT. THE NAPHTHA FROM CATALYTIC CRACKING (51% YIELD) OF A COAL SYN-CRUIDE WAS FOUND TO BE AN EXCELLENT GASOLINE BLENDING STOCK. THE NAPHTHA WAS USABLE AS A 44 VOLUME PERCENT COMPONENT OF A FINISHED, 96 RON (RESEARCH OCTANE NUMBER) UNLEADED GASOLINE (REMAINDER - 6% BUTANES, 30% REFORMATE, AND 20% ALKYLATE). ENGINE TESTING OF SIGNIFICANT SCALE AND DURATION WILL BE REQUIRED TO DETERMINE AND DESCRIBE THE REQUIREMENTS FOR MUTUAL ADAPTATION OF NEW AUTOMOTIVE ENGINES AND SYNTHETIC FUELS. MULTIPLE-BARREL LOTS OF TEST FUELS WILL BE NEEDED EVEN FOR THE EXPLORATORY PHASES OF SUCH TESTING. PROVISION FOR PRODUCTION OF SUCH TEST FUELS SHOULD BE A PRIME ELEMENT IN ALL PHASES OF A SYNTHETIC FUELS DEVELOPMENT PROGRAM.

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#### APPLICATION OF A NEW COMBUSTION ANALYSIS METHOD IN THE STUDY OF ALTERNATE FUEL COMBUSTION AND EMISSION CHARACTERISTICS

THE NEW COMBUSTION ANALYSIS METHOD IS BASED ON A MEASURE OF THE LOGARITHM OF THE PRODUCT PRESSURE TIMES VOLUME(SUPERSCRIPTED GAMMA VINCULUM) WHERE GAMMA VINCULUM REPRESENTS AN EFFECTIVE SPECIFIC HEAT RATIO FOR GASES IN THE COMBUSTION CHAMBER. RATIONALE FOR USE OF SUCH MEASUREMENTS IS ESTABLISHED BY REFERENCE TO CONVENTIONAL KNOWLEDGE OF ENGINE PROCESSES AND TO THERMODYNAMICS. THE INSTRUMENTATION REQUIRED FOR MEASUREMENT IS DESCRIBED, AND INSTRUMENT PERFORMANCE CHARACTERISTICS ARE ILLUSTRATED. THE RESULTS OBTAINED FOR METHANOL ARE COMPARED TO THOSE FOR A GASOLINE AT CORRESPONDING ENGINE OPERATING CONDITIONS AND EXHAUST GAS RECIRCULATION (EGR) LEVELS. METHANOL EXHIBITS SHORTER IGNITION DELAY INTERVALS AND BURN DURATIONS THAN GASOLINE. IGNITION DELAYS AND BURN DURATIONS FOR BOTH FUELS ARE EXTENDED AS ENGINE LOAD IS DECREASED, AS THE FUEL/AIR (F/A) MIXTURE IS MADE LEAN, AND AS THE EGR LEVEL IS INCREASED. WITH INCREASING SPARK ADVANCE, IGNITION DELAY PERIODS FOR BOTH FUELS ARE EXTENDED WHILE BURN DURATIONS ARE SHORTENED.

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AT THE SAME EQUIVALENCE RATIO, AIR MASS FLOW RATE, SPEED, SPARK TIMING, AND EGR RATE ENGINE POWER OUTPUT WITH METHANOL IS ABOUT 10% HIGHER THAN WITH GASOLINE. UNDER SIMILAR CONDITIONS BUT WITH CONSTANT POWER OUTPUT VOLUME-BASED FUEL CONSUMPTION WITH METHANOL IS ABOUT TWICE THAT WITH GASOLINE, AND ENERGY UTILIZATION IS MORE EFFICIENT. METHANOL EXHIBITS LOWER INDICATED SPECIFIC CARBON MONOXIDE (CO) EMISSIONS AT RATIOS (ACTUAL F/A RATIO TO THE STOICHIOMETRIC F/A RATIO GREATER THAN APPROXIMATELY 1.05, AND HIGHER CO EMISSIONS AT LEANER MIXTURE RATIOS. NITROGEN OXIDE (NO) EMISSIONS WITH METHANOL ARE LOWER THAN THOSE WITH GASOLINE AT COMMON OPERATING CONDITION MIXTURE RATIOS, AND EGR LEVELS. HYDROCARBON (HC) EMISSIONS WITH METHANOL ARE GENERALLY HIGHER THAN THOSE WITH GASOLINE AT CORRESPONDING NONMISFIRING MIXTURE RATIOS AND EGR LEVELS. LEAN MISFIRE LIMITS WITH METHANOL ARE EXTENDED BY ABOUT 0.5 EQUIVALENCE RATIOS RELATIVE TO THOSE WITH GASOLINE AT ALL EGR LEVELS. INVESTIGATION OF METHANOL HAS THE GREATER TOLERANCE TO EG

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#### ENGINE PERFORMANCE AND EXHAUST EMISSION CHARACTERISTICS OF A METHANOL-FUELED AUTOMOBILE

RESULTS OF LABORATORY AND ROAD TESTS ARE REPORTED WHICH SHOW THAT METHANOL IS A VERY ATTRACTIVE, CLEAN-BURNING ALTERNATIVE FUEL FOR AUTOMOBILES AND HAS RELATIVELY FEW MINOR PROBLEMS WHICH CAN BE OVERCOME. NUMBER OF VW PRODUCTION VEHICLES HAVE BEEN CONVERTED TO METHANOL OPERATION THROUGH THE USE OF AN EXHAUST-HEATED INTAKE MANIFOLD COMBINED WITH A HEATING FEATURE USING ENGINE COOLANT AND, OF COURSE, MODIFIED CARBURETOR. TESTS INDICATED THAT MORE POWER IS OBTAINED WITH METHANOL BECAUSE ITS HIGHER HEAT OF VAPORIZATION COOLS THE MIXTURE ENTERING THE ENGINE MUCH MORE THAN GASOLINE. THE GAIN IN POWER OUTPUT WITH PURE METHANOL IS ABOUT 10%. WHEN THE VEHICLE IS OPERATED ON PURE METHANOL, NEEDS SOME FORM OF COLD-STARTING AID FOR AMBIENT TEMPERATURES BELOW 8°C. THERE ARE SEVERAL POSSIBILITIES FOR IMPROVING COLD-STARTING AND WARM-UP, SUCH AS ADDING VOLATILE STARTING ADDITIVES TO METHANOL USING SPECIAL "COLD START" SUBSTANCES (E. G. BUTANE, METHYL ETHER, GASOLINE) WHICH ARE SPRAYED INTO THE INTAKE AIR DURING STARTUP OR EMPLOYING A SMALL FLAME PREHEATER

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THE INTAKE MANIFOLD VAPOR LOCK IS NOT A PROBLEM; FURTHERMORE, TESTS WITH CARS MODIFIED TO RUN ON METHANOL INDICATED ACCEPTABLE TO GOOD COLD-START DRIVEABILITY. FUEL ECONOMY WAS MEASURED DURING EXHAUST EMISSION TESTS, DRIVEABILITY TESTS, AND SPECIFIC FUEL ECONOMY TESTS. BECAUSE OF METHANOL'S LOWER ENERGY CONTENT, MASS SPECIFIC FUEL CONSUMPTION IS NOTICEABLY GREATER THAN WITH GASOLINE. HOWEVER, FUEL CONSUMPTION RELATED TO CONSUMED ENERGY IS CONSIDERABLY LOWER THAN THAT WITH GASOLINE. THIS MEANS THAT METHANOL BURNED MORE EFFICIENTLY THAN GASOLINE. AT 2000 RPM AND WIDE-OPEN-THROTTLE (WOT), A 17% INCREASE IN BRAKE EFFICIENCY HAS BEEN OBSERVED. CARBON MONOXIDE (CO) EMISSIONS FROM THE METHANOL-FUELED ENGINE CORRESPOND APPROXIMATELY TO THOSE FROM THE GASOLINE ENGINE. HOWEVER, TESTS ON A VW PASSAT FOUR-CYLINDER ENGINE AT WOT AND VARIOUS ENGINE SPEEDS SHOWED THAT IT IS POSSIBLE TO REDUCE CO EMISSIONS FROM THE METHANOL ENGINE, ESPECIALLY AT LOW ENGINE SPEEDS AS COMPARED TO GASOLINE. ALSO WITH METHANOL, A SIGNIFICANT REDUCTION IN NITROGEN OXIDES (NOX) AND VERY LOW LEVELS OF HYDROCARBONS WERE OBSERVED. AT THE SAME COMPRESSION RATIO, ALDEHYDE EMISSIONS USING METHANOL ARE NOTICEABLY HIGHER THAN WITH GASOLINE. HOWEVER, THESE EMISSIONS CAN BE REDUCED BY INCREASING THE COMPRESSION RATIO, CONTROLLING THE COMBUSTION PROCESS, AND ADDING UP TO 10% WATER TO METHANOL. POLYNUCLEAR AROMATIC HC EMISSIONS, SOME OF WHICH ARE REGARDED AS SEVERELY CARCINOGENIC, ARE MORE THAN ONE ORDER OF MAGNITUDE LOWER WITH METHANOL THAN WITH GASOLINE.

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#### COMBUSTION OF METHANOL IN AN AUTOMOTIVE GAS TURBINE

ANALYTICAL AND EXPERIMENTAL STUDIES WERE CARRIED OUT TO ASSESS THE EFFECTS OF METHANOL AS A FUEL FOR THE GT-225 EXPERIMENTAL PASSENGER-CAR, GAS-TURBINE ENGINE. THE THERMODYNAMIC ANALYSES INDICATED THAT THE ENGINE PERFORMANCE WITH METHANOL WOULD NOT BE CHANGED SIGNIFICANTLY FROM THAT OBSERVED WITH KEROSENE. AFTER THE ENGINE FUEL HANDLING SYSTEM WAS SUITABLY MODIFIED FOR METHANOL, DYNAMOMETER ENGINE TESTING CONFIRMED THAT THE ENGINE PERFORMED AS WELL ON METHANOL AS ON KEROSENE. USING A CON-

VENTIONAL DIFFUSION FLAME COMBUSTOR, NITROGEN OXIDES (NOX) EMISSIONS WERE REDUCED BY ABOUT 70% FOR ALL CONDITIONS. CARBON MONOXIDE (CO) EMISSIONS WERE REDUCED BY ABOUT 25% OVER THE NORMAL ENGINE OPERATING RANGE, BUT WERE INCREASED BY UP TO 165% AT HIGH ENGINE LOADS WHEN USING METHANOL. THE HYDROCARBON (HC) AND ALDEHYDE EMISSIONS WERE LOW FOR BOTH FUELS, BUT METHANOL OPERATION PRODUCED SOMEWHAT MORE OF BOTH. TESTS OF THE ENGINE INSTALLED IN A CHASSIS RIG IN THE CHASSIS DYNAMOMETER AND OPERATED ON THE 1975 FEDERAL TEST PROCEDURE (FTP) EMISSION SCHEDULE AND USING THE FEDERAL HWY. FUEL ECONOMY TESTS (HWFET) CONFIRMED THAT THE ENERGY CONSUMPTION OF THE VEHICLE OPERATING ON METHANOL WAS ABOUT THE SAME AS WITH KEROSENE. AT LOW MILEAGE, THE VEHICLE EASILY PASSED THE 1978 FEDERAL EMISSION STANDARDS FOR HC AND CO (0.25 G/KM AND 2.1 G/KM, RESPECTIVELY) WITH EITHER FUEL, AND ALSO PASSED THE 1977 CALIFORNIA STANDARD FOR NOX (0.93 G/KM) WITH METHANOL. NO ATTEMPT WAS MADE TO DETERMINE EMISSION DETERIORATION FACTORS. THE DRIVEABILITY WITH METHANOL WAS AS LEAST AS GOOD AS WITH KEROSENE.

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#### ALTERNATIVE FUELS FOR AUTOMOTIVE DIESEL ENGINES

REAL ALTERNATIVE FUELS FOR THE DIESEL ENGINE ARE LIMITED TO THOSE HAVING A GOOD SELF-IGNITION QUALITY WHICH INCLUDE KEROSENE AND THE HEAVIER DISTILLATES WHETHER FROM OIL OR COAL. THESE FUELS CAN BE SUBSTITUTED DIRECTLY FOR GAS OIL WITH NO CHANGE IN COMBUSTION REQUIREMENTS. MAXIMUM FUEL SETTINGS MUST BE ADJUSTED TO COMPENSATE FOR THE VARIED VOLUMETRIC CALORIFIC VALUES, AND PROVISION MUST BE MADE TO ENSURE ADEQUATE FUEL PUMP LUBRICATION. WITH RESPECT TO GASOLINES AND HEAVIER FUEL OILS, INJECTION TIMING AND/OR COMPRESSION RATIO WILL HAVE TO BE CHANGED BECAUSE OF THESE FUELS' SIGNIFICANTLY LOWER IGNITION QUALITY. HEATED INLET AIR OR ADDITIVES MAY ALSO BE NEEDED. THESE FUELS ALSO SHOW A PREFERENCE FOR COMBUSTION SYSTEM, I.E. DIRECT INJECTION (D.I.) FOR GASOLINE, INDIRECT INJECTION (I.D.I.) FOR HEAVY FUEL OILS. REGARDING METHANOL AND GASES INCLUDING HYDROGEN, ON ACCOUNT OF THEIR VERY LOW IGNITION QUALITY AND, IN THE CASE OF GASES, THE DIFFICULTY OF ACHIEVING LOCALLY RICH MIXTURES FOR IGNITION, IT IS

NECESSARY, IN COMPRESSION IGNITION ENGINES, TO USE THE DUAL-FUEL APPROACH. THIS MEANS EITHER DUPLICATE FUEL INJECTION SYSTEMS OR A MEANS OF INTRODUCING THE FUEL WITH THE AIR. ASPIRATED FUEL/AIR MIXTURE INTRODUCES THE PROBLEMS OF KNOCK, PRE-IGNITION, AND UNBURNED HYDROCARBONS (HC) DUE TO WEAK MIXTURE AREAS IN THE ENGINE CYLINDER. KNOCK AND PRE-IGNITION HAVE THE OVERALL EFFECT OF LIMITING THE PROPORTION OF THE ALTERNATIVE FUEL THAT CAN BE BURNED. IN ORDER TO MAXIMIZE UTILIZATION, THE METERING AND CONTROL OF ENGINE OPERATING PARAMETERS BECOME COMPLEX, ESPECIALLY UNDER TRANSIENT CONDITIONS OR WHERE A WIDE SPEED RANGE IS REQUIRED. THE VERY LOW IGNITION QUALITY AND/OR OTHER PHYSICAL PROPERTIES PRECLUDE THE USE OF COAL TARS AND RESIDUAL FUELS AS AUTOMOTIVE FUELS UNLESS BLENDED WITH GAS OIL OR OTHER LIGHT DISTILLATES. EVEN SO, TO MAINTAIN ADEQUATE IGNITION QUALITY AND BURNING RATE, THE DILUTED FUEL WILL BE PREDOMINANTLY GAS OIL AND THE SUBSTITUTION RATE WILL BE TOO LOW FOR THESE FUELS TO BE ENTERTAINED AS REAL ALTERNATIVES. THE ONLY POSSIBILITY OF THEIR USE, UNDILUTED, LIES IN THE PROVISION OF HEATED FUEL SYSTEMS AND PROBABLY A MEANS OF IGNITION. MODIFICATION OF THE DIESEL ENGINE TO RUN ON LOWER IGNITION QUALITY FUELS MAY NOT PROVE ECONOMIC OR PRACTICAL EXCEPT IN THE LARGER TRUCK ENGINES. THERE WOULD APPEAR TO BE A CASE TO WIDEN THE DIESEL FUEL CUT OF THE BARREL, AND DEVELOP A DIESEL ENGINE TO OPERATE ON THIS FUEL IN ORDER TO CONSERVE OIL-BASED FUELS IN THE AUTOMOTIVE FIELD. FOR THE MOST DIFFICULT FUELS, PARTICULARLY METHANOL, SPECIAL ENGINES SHOULD BE DEVELOPED TO ENSURE THEIR MOST EFFICIENT USE. FINALLY, SPARK IGNITION OF FUEL SPRAYS MAY PLAY AN IMPORTANT PART IN FUTURE ALTERNATIVE FUEL ENGINES BY HELPING TO PERPETUATE THE HIGH COMPRESSION RATIO, UNTHROTTLED OPERATION OF THE DIESEL ENGINE.

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#### **HYDROGEN AS A RECIPROCATING ENGINE FUEL**

ANALYTICAL AND EXPERIMENTAL STUDIES HAVE SHOWN HYDROGEN TO BE A SUITABLE FUEL FOR SPARK IGNITED RECIPROCATING ENGINES. THE ANALYTICAL PORTION INVOLVED APPLICATION OF A THERMODYNAMIC MODEL TO PREDICT TRENDS IN POWER, EFFICIENCY, AND EMISSIONS WITH HYDROGEN FUEL. THE EXPERIMENTAL INVESTIGATION WAS CARRIED OUT USING A SINGLE-CYLINDER CFR (COOPERATIVE FUEL RESEARCH) ENGINE

MODIFIED TO RUN ON HYDROGEN. AS A RESULT, THE WIDE FLAMMABILITY LIMITS FOR HYDROGEN-AIR MIXTURES, UNTHROTTLED QUALITY REGULATION OF POWER IS POSSIBLE WITH HYDROGEN. SUCH OPERATION MAKES SIGNIFICANT EFFICIENCY GAINS POSSIBLE COMPARED WITH THROTTLED OPERATION ON ISOOCTANE. ALTHOUGH THE HIGH DENSITY OF HYDROGEN LIMITS ENGINE POWER, OUTPUT WITH A PREMIXED CHARGE, DIRECT CYLINDER FUEL INJECTION MAY BE USED TO INCREASE SIGNIFICANTLY THE CHARGE DENSITY AND THUS THE POWER OUTPUT. HOWEVER, WITH DIRECT CYLINDER INJECTION, CARE MUST BE TAKEN TO ENSURE THAT INCOMPLETE COMBUSTION DUE TO INADEQUATE FUEL/AIR MIXING IS AVOIDED. IN EXPERIMENTAL STUDIES, LATE INJECTION, DIRECTED RADIALLY INWARD IN THE CYLINDER, RESULTED IN INCOMPLETE COMBUSTION, WHILE INJECTION EARLIER IN THE CYCLE RESULTED IN NEARLY COMPLETE COMBUSTION. NITRIC OXIDE (NO) EMISSIONS FROM HYDROGEN-FUELED ENGINES ARE GOVERNED BY THE SAME THERMOCHEMICAL PROCESSES WHICH DETERMINE THESE EMISSIONS WHEN HYDROCARBON (HC) FUELS ARE USED. IN NEAR STOICHIOMETRIC MIXTURES, NITROGEN OXIDES (NOX) EMISSIONS WITH HYDROGEN ARE CONSIDERABLY HIGHER THAN WITH HC FUELS. HOWEVER, THE LEAN OPERATION POSSIBLE WITH HYDROGEN ENABLES OPERATION IN REGIMES OF VERY LOW NOX EMISSIONS. ALSO, HYDROGEN'S RAPID BURNING VELOCITY INDICATES A HIGH TOLERANCE FOR EXHAUST GAS RECIRCULATION. CONTROL OF NOX WITHOUT FUEL ECONOMY PENALTY. THUS, THE FLEXIBILITY OF HYDROGEN FUEL DUE TO ITS COMBUSTION CHARACTERISTICS PERMITS TAILORING OF THE ENGINE TO MINIMIZE NOX EMISSIONS.

by W. J. MCLEAN; P. C. T. DE BOER; H. S. HOMAN; FAGELSON  
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 PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW

YORK, 1977 P297-319

1977; 15REFS

PRESENTED AT SYMPOSIUM ON FUTURE  
 AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1977

Availability: IN HS-023 205

HS-023 220

#### **HYDRONITROGENS AS FUTURE AUTOMOTIVE FUELS**

A GROUP OF SYNTHETIC FUELS CALLED HYDRONITROGENS HAS BEEN EVALUATED AS AUTOMOTIVE FUELS FOR THE TIME PERIOD BEYOND THE YEAR 2000. HYDRONITROGEN FUELS ARE COMPOSED OF HYDROGEN AND NITROGEN. AS SUCH, THEY CAN BE SYNTHESIZED FROM AIR AND WATER WITHOUT THE USE OF FOSSIL FUELS. THE MAIN HYDRONITROGEN FUELS ARE HYDRAZINE,  $N_2H_4$ , AND AMMONIA,  $NH_3$ . AMMONIA BY ITSELF HAS BEEN READY BEEN TESTED EXTENSIVELY BY OTHER INVESTIGATORS AND WAS FOUND TO HAVE PLEASING COMBUSTION PROPERTIES. NO WORK HAS BEEN REPORTED TO DATE ON HYDRAZINE COMBUSTION.

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INTERNAL COMBUSTION ENGINES, BUT HYDRAZINE BURNING VELOCITY IN AIR IS EXPECTED TO BE HIGHER THAN THAT OF AMMONIA OR HYDROCARBONS (HC). THIS WILL RESULT IN MORE RAPID AND MORE COMPLETE COMBUSTION. WHEN COMPLETELY BURNED, AND AFTER REMOVING EVENTUALLY FORMED NITROGEN OXIDES (NO<sub>x</sub>), HYDRONITROGEN FUELS WOULD BE NONPOLLUTING TO THE ENVIRONMENT. SO FAR, OTHER AUTHORS HAVE CONSIDERED AMMONIA OR HYDRAZINE FOR AUTOMOTIVE FUELS AS PURE SUBSTANCES ONLY. HOWEVER, THE FULL ADVANTAGES OF THESE FUELS CAN BEST BE ACHIEVED IN BINARY OR TERNARY MIXTURES OF HYDRAZINE WITH AMMONIA AND/OR WATER, WHICH HAVE FREEZING POINTS AS LOW AS -65° F. SELECTION CRITERIA FOR HYDRONITROGEN FUEL MIXTURES ARE DISCUSSED. THE PREPARATION OF HYDRONITROGEN FUELS, PRODUCTION STATISTICS, ADAPTABILITY AND PERFORMANCE IN AUTOMOTIVE ENGINES, AND SAFETY AND MATERIALS COMPATIBILITY ARE SUMMARIZED. THE RESULTS OF AN EVALUATION MATRIX OF HYDRONITROGENS VS. OTHER NONCONVENTIONAL FUELS FOR THE TIME PERIOD BEYOND 2000 ARE DISCUSSED, AND RESULTS OF PRELIMINARY TESTS WITH HYDRAZINE AND AMMONIA MIXTURES IN A SINGLE-CYLINDER INTERNAL COMBUSTION ENGINE ARE PRESENTED. THE RESEARCH HAS SHOWN THAT HYDRONITROGEN FUELS ARE Viable CANDIDATES FOR THE POST-Fossil-Fuel ERA FOR AUTOMOTIVE PROPULSION. ADDITIONAL TESTING IS REQUIRED CLEARLY TO ANSWER QUESTIONS ABOUT SPECIFIC FUEL CONSUMPTION AND THERMAL EFFICIENCY IN AN INTERNAL COMBUSTION ENGINE. THE IMPLEMENTATION OF A HYDRONITROGEN FUEL TRANSPORTATION ECONOMY DEPENDS ON THE REALIZATION OF NOVEL SYNTHESIS METHODS WHICH WOULD ALLOW ECONOMICALLY COMPETITIVE PRODUCTION OF FUELS FROM AIR AND WATER (WITH ELECTRICAL ENERGY PROVIDED BY ANOTHER SOURCE). IN PARTICULAR, IT DEPENDS ON THE DEGREE TO WHICH THE HYDRONITROGEN SYSTEM IS COMPETITIVE WITH OTHER SYNTHETIC FUEL CANDIDATES.

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GM-R-68600

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1977; 13REFS  
PRESENTED AT SYMPOSIUM ON FUTURE AUTOMOTIVE FUELS, WARREN, MICH., 6-7 OCT 1975.  
Availability: IN HS-023 205

HS-023 221

#### IMPACTS OF SYNTHETIC LIQUID FUEL DEVELOPMENT FOR THE AUTOMOTIVE MARKET

THE ENVIRONMENTAL, SOCIAL, ECONOMIC, AND INSTITUTIONAL IMPACTS OF PRODUCING SYNTHETIC FUELS DERIVED FROM COAL AND OIL SHALE WERE INVESTIGATED. FROM DISCUSSIONS WITH ENERGY INDUSTRY SOURCES, IT WAS CONCLUDED THAT THE BLENDING OF SYNTHETIC AND NATURAL CRUDE OILS IS A MORE REALISTIC OPTION THAN THE INDE-

PENDENT DEVELOPMENT OF A SEPARATE SYNTHETIC FUELS INDUSTRY. THEREFORE, THIS STUDY FOCUSED ON THE RESOURCE-TO-SYNTHETIC CRUDE PORTION OF THE PROCESS CHAIN BECAUSE DIFFERENCES FROM PRESENT PRACTICE WOULD BE MOST EVIDENT THERE. BECAUSE THESE SOURCES OF CRUDE OIL ARE NOT YET ECONOMICALLY COMPETITIVE, EVEN WITH TODAY'S HIGH OIL PRICES, A KEY ASPECT OF THE STUDY WAS AN EXAMINATION OF THE PROFITABILITY OF THE SYNTHETIC FUELS ENTERPRISE, THE BUSINESS RISKS DERIVING FROM UNSTABLE POLICIES AND ECONOMIC CONDITIONS, AND THE PROCESS BY WHICH DECISIONS TO IMPLEMENT THE INDUSTRY WILL BE MADE. THE FOLLOWING FACTORS ARE ESPECIALLY CRITICAL TO SYNTHETIC LIQUID FUEL DEVELOPMENT, WHETHER DESTINED FOR AUTOMOTIVE USE OR OTHER APPLICATIONS: RECLAMATION OF MINED LANDS, POSSIBLE WATER SHORTAGES IN THE ARID WEST, AIR POLLUTION FROM CONVERSION PLANTS, EXTREMELY RAPID COMMUNITY GROWTH RATES IN RURAL AREAS, SOCIOECONOMIC INSTABILITY, CONFLICTS BETWEEN TRADITIONAL LOCAL AND NEW INDUSTRIAL INTERESTS, LOSS OF LOCAL AUTONOMY, AND ECONOMIC RISK MITIGATION FOR FUEL PRODUCERS. IN GENERAL, IT SEEMS THAT NO SINGLE SYNTHETIC LIQUID FUELS OPTION IS BEST IN ALL RESPECTS; ALL OPTIONS WOULD HAVE LARGE ENVIRONMENTAL, SOCIAL, AND INSTITUTIONAL IMPACTS, ESPECIALLY IN RESOURCE DEVELOPMENT AND FUEL CONVERSION AREAS.

by E. M. DICKSON; E. E. HUGHES  
STANFORD RES. INST., MENLO PARK, CALIF.  
Publ: HS-023 205, "FUTURE AUTOMOTIVE FUELS. PROSPECTS, PERFORMANCE, PERSPECTIVE," NEW YORK, 1977 P342-66  
1977; 5REFS  
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Availability: IN HS-023 205

HS-023 222

#### THE NONRESIDENT VIOLATOR COMPACT OF 1977 [TRAFFIC VIOLATIONS LEGISLATION]

UNDER THE NONRESIDENT VIOLATOR COMPACT OF 1977, A RECIPROCAL AGREEMENT AMONG STATES REGARDING TRAFFIC VIOLATIONS, THE VIOLATOR'S HOME STATE IS NOTIFIED IF HE/SHE FAILS TO PAY A FINE OR APPEAR IN COURT TO ANSWER CHARGES, AND THE HOME STATE BEGINS PROCEEDINGS TO SUSPEND THE VIOLATOR'S DRIVER'S LICENSE. THE LICENSE SUSPENSION REMAINS IN EFFECT UNTIL THE INDIVIDUAL PRODUCES PROOF OF HAVING SATISFIED THE TERMS OF THE CITATION, EITHER IN THE FORM OF A RECEIPT FOR PAYMENT OF FINE OR PROOF OF APPEARANCE IN COURT. THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) DEVELOPED A MODEL NONRESIDENT VIOLATOR COMPACT IN 1976 WHICH CONTAINS A DESCRIPTION OF THE PROCEDURES USED UNDER THE COMPACT, BENEFITS OF COMPACT MEMBERSHIP, THREE WAYS THAT ENTRY INTO COMPACT MEMBERSHIP CAN BE ACHIEVED, AND THE FORM OF A RESOLUTION OF RATIFICATION FORMALIZING COMPACT ENTRY. THE COUNCIL OF STATE GOVERNMENTS, THE AMERICAN

ASSOC. OF MOTOR VEHICLE ADMINISTRATORS, AND AN ADVISORY GROUP OF NATIONALLY RECOGNIZED LEADERS IN THE AREAS OF MOTOR VEHICLE ADMINISTRATION AND TRAFFIC SAFETY ASSISTED THE NHTSA. ENTRY INTO THE NONRESIDENT VIOLATOR COMPACT OF 1977 MAY BE ACCOMPLISHED IN THE FOLLOWING THREE DIFFERENT WAYS: FOR STATES ALREADY ENTERED INTO RECIPROCAL AGREEMENT, SUBMITTAL OF A RESOLUTION OF JOINDER BY THE STATE'S MOTOR VEHICLE ADMINISTRATOR; AUTHORIZATION BY THE STATE LEGISLATURE TO THE STATE'S MOTOR VEHICLE ADMINISTRATOR TO ENTER INTO THE COMPACT; AND ADOPTION OF THE FULL COMPACT AS A LEGISLATIVE STATUTE BY THE STATE LEGISLATURE. ONCE AUTHORITY IS ESTABLISHED, THE PROCESS ONLY REQUIRES THE AUTHORIZED OFFICIAL TO FORWARD A RESOLUTION OF RATIFICATION OF THE COMPACT TO THE SECRETARIAT OF THE AMERICAN ASSOC. OF MOTOR VEHICLE ADMINISTRATORS, WHO INFORMS THE OTHER SIGNATORY JURISDICTIONS OF THE NEW COMPACT MEMBER. SOME OF THE ADVANTAGES OFFERED BY THIS COMPACT TO THE STATES ARE AS FOLLOWS: SAVING IN HOURS OF LAW ENFORCEMENT TIME, INCREASE IN LOCAL COURT INCOME, SAVING OF TIME FOR THE MOTORIST, AND REDUCTION IN NONRESIDENT TRAFFIC VIOLATIONS. MARYLAND IS THE FIRST STATE TO ADOPT THE COMPACT.

by ROBERT F. STONE

Publ: TRAFFIC SAFETY V78 N5 P8-9, 29-30 (MAY 1978)

1978; 1REF

Availability: SEE PUBLICATION

### **HOW THE MARYLAND STATE POLICE ENFORCE THE 55-MILE-PER-HOUR LIMIT**

THE VARIOUS APPROACHES TO ENFORCEMENT OF THE 55 MPH SPEED LIMIT BY THE MARYLAND STATE POLICE DURING RECENT YEARS IS REVIEWED. ON 28 JUL 1975, THE MARYLAND STATE POLICE BEGAN THE MOST STRINGENT CAMPAIGN AGAINST SPEEDERS EVER CONDUCTED IN THE STATE: UNDER A MANDATE FROM THE GOVERNOR, ALL SPEEDING VIOLATORS WERE TO RECEIVE CITATIONS CARRYING THE FULL FINE AND APPROPRIATE PENALTY. THE COURTS WERE REQUESTED TO IMPOSE MAXIMUM PENALTIES ON VIOLATORS. SEVERAL OF THE MORE SIGNIFICANT POINTS OF A TEN-POINT ENFORCEMENT PROGRAM AND PUBLIC INFORMATION CAMPAIGN DEVELOPED BY THE STATE POLICE INCLUDED THE FOLLOWING: STRICT ENFORCEMENT OF THE NATIONAL 55 MPH SPEED LIMIT WITH NO TOLERANCE; USE OF NONTRADITIONAL VEHICLES, INCLUDING FOREIGN CARS AND TRUCKS; HIGH VISIBILITY OF MARKED STATE POLICE CARS; USE OF ROLLING ROADBLOCKS IN AREAS OF CONTINUING NONCOMPLIANCE; USE OF CONCEALED ELECTRONIC SPEED TIMING DEVICES, INCLUDING STATIONARY RADAR, "MOVING" RADAR, AND VASCAR; AND USE OF SPECIAL SUPPLEMENTAL ENFORCEMENT PERSONNEL FROM HEADQUARTERS TO ASSIST REGULAR ENFORCEMENT OFFICERS. PRESS COVERAGE WAS EXTENSIVE FOR THE HARD-

HITTING PUBLIC INFORMATION CAMPAIGNS WERE SHOWN TECHNIQUES THE STATE POLICE WOULD USE IN ITS ANTISPEEDING CRACKDOWN. THE OBJECTIVE OF THE PI WAS NOT TO MAKE A HIGH NUMBER OF ARRESTS BUT RATHER TO ENCOURAGE VOLUNTARY COMPLIANCE WITH THE 55 MPH SPEED LIMIT. SPEED ENFORCEMENT CONTINUED THROUGHOUT THE STATE AND THE DEATH RATE ON THE HIGHWAY CONTINUED TO DECREASE. AT THE SAME TIME, THE NUMBER OF ALCOHOL-RELATED ACCIDENTS WAS CONTINUING TO INCREASE. AS A RESULT, AN ADDITIONAL ALCOHOL AND SPEED ENFORCEMENT CAMPAIGN CALLED OPERATION YELLOW JACKET WAS LAUNCHED. ADDITIONAL TROOPERS WERE USED TO SUPPLEMENT REGULAR PATROLS; THE OPERATION USED ONE TROOPER, ON AN OVERTIME BASIS, TO SELECTED HIGH-ACCIDENT LOCATIONS THROUGHOUT THE STATE. A MAJOR PRESS CONFERENCE WAS HELD IN JAN 1977 TO ANNOUNCE THE PROGRAM AND SPECIFIC INFORMATION (LEVELS OF ALCOHOL FOUND IN THE BLOOD OF DRIVERS KILLED IN TRAFFIC ACCIDENTS, NUMBER OF PASSENGERS AND PEDESTRIANS KILLED WHO HAD ALCOHOL IN THEIR BLOOD, AND LONG-TERM FATALITY TRENDS IN THE STATE) WAS DISTRIBUTED TO ALL THE NEWS MEDIA WITHIN THE STATE AND IN THE DISTRICT OF COLUMBIA. A NEW LONG-RANGE RADAR SET WAS UNVEILED, AND A LOGO REPRESENTING THE PROGRAM WAS AFFIXED TO EACH PROJECT VEHICLE. A PRELIMINARY EVALUATION OF OPERATION YELLOW JACKET IS PRESENTLY UNDERWAY AND PRELIMINARY RESULTS ARE POSITIVE; ENFORCEMENT ACTIVITY HAS BEEN HIGH (1.5 VIOLATOR CONTACTS EACH MILE OF ROAD PATROL DRIVEN). CONTINUING ENFORCEMENT EFFORTS DURING THE PAST THREE YEARS HAVE BEEN A VITAL FACTOR IN MARYLAND'S DOWNWARD TREND IN TRAFFIC FATALITIES.

by WILLIAM E. CLARK

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Availability: SEE PUBLICATION

### **ESTIMATING THE NUMBER OF ACCIDENTS AT INTERSECTIONS FROM A KNOWLEDGE OF TRAFFIC FLOWS ON THE APPROACHES**

THE RELATIONSHIP OF THE NUMBER OF ACCIDENTS AT INTERSECTIONS AND THE TRAFFIC FLOW ON THE APPROACHES WAS INVESTIGATED. THE INCREASE IN THE NUMBER OF ACCIDENTS AT INTERSECTIONS, RELATIVE TO NONJUNCTION ACCIDENTS, MAY BE EXPLAINED BY THE BASIC FACT THAT INCREASE IN THE NUMBER OF VEHICLES ON THE ROAD IS GENERALLY ACCCOMPANIED BY AN INCREASE IN THE NUMBER OF COLLISIONS, WHICH RISE AT A FASTER RATE THAN SINGLE-VEHICLE ACCIDENTS. GENERALLY, MORE THAN 50% OF COLLISIONS OCCUR AT INTERSECTIONS. DATA FROM A NUMBER OF COUNTRIES STUDIED SUPPORT THE ABOVE STATEMENT AND SHOW THAT OVER

YEARS, THE NUMBER OF INTERSECTION ACCIDENTS HAS INCREASED AT A FASTER RATE THAN OTHER ACCIDENTS. A STATISTICAL ANALYSIS OF THE GENERAL TRENDS IN THE NUMBER OF INTERSECTION ACCIDENTS, THEIR SEVERITY, AND AN ANALYSIS OF TYPES OF ACCIDENTS AT INTERSECTIONS WERE MADE. A MODEL WAS DEVELOPED WHICH ENABLES THE ESTIMATION OF THE EXPECTED NUMBER OF ACCIDENTS AT INDIVIDUAL INTERSECTIONS. IT WAS FOUND THAT VEHICLE EXPOSURE CAN BE USED AS THE BASIS FOR ESTIMATION. THE EXPOSURE, DEFINED AS THE NUMBER OF OCCASIONS FOR ACCIDENTS, WAS CALCULATED THROUGH THE SUM OF THE PRODUCTS OF FLOW AT THE 24 POINTS WHERE VEHICLE PATHS CROSS OR MERGE. THIS MEASURE OF EXPOSURE, EXPRESSED AS A TRAFFIC FLOW INDEX, SHOWED GOOD CORRELATION WITH THE NUMBER OF ACCIDENTS. ON THE ASSUMPTION THAT THE NUMBER OF ACCIDENTS AT AN INTERSECTION, IN A GIVEN TIME INTERVAL, IS POISSON DISTRIBUTED, SIGNIFICANCE TESTS WERE MADE COMPARING THE ACTUAL NUMBER OF ACCIDENTS WITH THE EXPECTED ACCORDING TO THE VEHICLE EXPOSURE INDEX. SUCH COMPARISONS ARE USEFUL IN THE DETERMINATION OF ACCIDENT "BLACK SPOTS" (INTERSECTIONS WHERE, GIVEN THE EXPECTED NUMBER OF ACCIDENTS, THE CHANCE THAT THE NUMBER OF ACCIDENTS IS EQUAL OR GREATER THAN THE ACTUAL NUMBER OCCURRING, IS SMALLER THAN A CERTAIN PROBABILITY).

by A. SHALOM HAKKERT; DAVID MAHALEL  
 Publ: ACCIDENT ANALYSIS AND PREVENTION V10 N1  
 P69-79 (1978)  
 1978; 28REFS  
 Availability: SEE PUBLICATION

HS-023 226

#### THE DRIVER AS CAUSE OR VICTIM IN VEHICLE SKIDDING ACCIDENTS

THE WIDESPREAD IMPLICATION, IF NOT THE EVIDENCE, THAT DRIVERS ARE THE PRINCIPAL CAUSE OF VEHICLE SKIDDING ACCIDENTS IS DISCUSSED AND REFUTED. THE QUESTION OF WHETHER OR NOT THE DRIVER CAN DO SOMETHING TO AVOID A SKIDDING ACCIDENT IS IRRELEVANT; THE QUESTION IS WHETHER THE DRIVER HAS THE KIND OF INFORMATION WHICH CAN BE EXPECTED TO LEAD HIM/HER TO CONCLUDE THAT THERE IS A SKID HAZARD. THIS QUESTION, IF ANSWERED IN THE NEGATIVE, VIRTUALLY ELIMINATES THE DRIVER AS THE CAUSE OF SKIDDING ACCIDENTS. AT BEST ONE MUST PLEAD IGNORANCE AND ATTRIBUTE MOST ACCIDENTS TO CHANCE WHICH IS A MORE DEFENSIBLE CAUSE THAN DRIVER ERROR CONSIDERING OUR PRESENT STATE OF KNOWLEDGE. AS LONG AS LOCATIONS WHICH ARE RECOGNIZED AS HAVING HIGH FREQUENCIES OF ACCIDENTS INVOLVE ONLY AN EXTREMELY SMALL PORTION OF THE VEHICLES PASSING THAT SITE, THE FEW THAT ARE INVOLVED IN ACCIDENTS HOLD THE KEY. A MAJOR DEFICIENCY STILL REMAINS IN THAT THERE HAS BEEN NO DEFINITIVE STUDY OF WHAT DRIVERS KNOW ABOUT SKIDDING AND SLIP-

PERINESS, OR ABOUT THEIR BEHAVIOR WITH REGARD TO WET ROADS AND SKIDDING. THE DRIVER'S APPRECIATION OF THE NEED TO CONTROL SPEED AND THE ENHANCEMENT OF CUES WHICH SIGNAL AN INCIPENT SKID SEEM TO BE THE MOST FRUITFUL PREVENTIVE APPROACHES TO THE SKIDDING PROBLEM. FOR THIS TO BE EFFECTIVE, MORE NEEDS TO BE KNOWN ABOUT WHAT DRIVERS CAN AND DO REACT TO AND HOW THESE CUES CAN BE CONTROLLED OR ENHANCED TO PROVIDE A LOWER RATE OF UNCONTROLLED SKIDDING ACCIDENTS. A RESEARCH PROGRAM IS OUTLINED FOR DEVELOPING THE TYPES AND QUALITY OF INFORMATION WHICH POTENTIALLY ARE AVAILABLE FOR BETTER SYSTEM PERFORMANCE.

by RICHARD A. OLSEN  
 Publ: ACCIDENT ANALYSIS AND PREVENTION V10 N1  
 P61-7 (1978)  
 1978; 31REFS  
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HS-023 226

#### EFFECTS OF MODERATE LEVELS OF BLOOD ALCOHOL ON RESPONSES TO INFORMATION FROM SIMULATED AUTOMOBILE REAR-SIGNAL SYSTEMS

THE EFFECTS OF FUNCTIONAL SEPARATION OF BRAKE AND TURN SIGNALS ON AN AUTOMOBILE, AND OF ALCOHOL CONSUMPTION BY A DRIVER, ON A DRIVER'S ABILITY TO DETECT AND INTERPRET REAR-SIGNAL INFORMATION FROM MODEL AUTOMOBILES IN A LABORATORY SETTING WERE INVESTIGATED. (WHILE FUNCTIONAL SEPARATION OF REAR-SIGNAL DISPLAYS (VS. A REAR-SIGNAL SYSTEM THAT HAS STOP AND TURN INFORMATION COMBINED UNDER ONE LENS) APPEARS TO BE A WORTHWHILE ACCIDENT COUNTERMEASURE, THERE IS NO EVIDENCE TO DATE TO INDICATE THAT IT WILL IMPROVE THE RESPONSES OF INTOXICATED DRIVERS TO REAR-SIGNAL INFORMATION.) TWELVE EXPERIENCED DRIVERS PERFORMED THE LABORATORY TASK FOR ONE-HOUR SESSIONS ON FIVE SUCCESSIVE DAYS. THREE INDEPENDENT VARIABLES WERE EXAMINED IN A RANDOMIZED-BLOCK FACTORIAL DESIGN. THESE CONSISTED OF TWO TYPES OF REAR-SIGNAL SYSTEMS (ONE WITH BRAKE AND TURN SIGNALS COMBINED UNDER THE SAME LENS AND THE OTHER WITH BRAKE AND TURN SIGNALS UNDER SEPARATE LENSES), FOUR LEVELS OF BLOOD ALCOHOL (0.00, 0.02, 0.05, AND 0.08%), AND SIX LEVELS OF STIMULUS COMPLEXITY (RIGHT TURN, RIGHT TURN PLUS BRAKE, LEFT TURN, LEFT TURN PLUS BRAKE, BRAKE ONLY, AND BRAKE MALFUNCTION). RESPONSE ERRORS AND THE LATENCIES BETWEEN THE ONSET OF THE STIMULUS AND BOTH THE ONSET OF THE RESPONSE AND THE COMPLETION OF THE RESPONSE WERE MEASURED. RESULTS INDICATED THAT RESPONSE VARIABLES WERE NOT EQUALLY SENSITIVE TO THE TASK AND THAT PERFORMANCE WAS SIGNIFICANTLY AFFECTED BY MODEL TYPE AND STIMULUS COMPLEXITY. PERFORMANCE DETERIORATED WITH BLOOD ALCOHOL LEVELS (BAL'S) AS LOW AS 0.05% ON THE COMBINED MODEL AND 0.08% ON THE

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MODEL THAT SEPARATED BRAKE AND TURN-SIGNAL LIGHTS. THE RESULTS OF SEPARATE ANALYSES PERFORMED WITH EACH OF THE DEPENDENT VARIABLES INDICATE THAT MEASURING BOTH "MOVEMENT" AND REACTION TIME WAS SLIGHTLY MORE SUCCESSFUL THAN MEASURING REACTION TIME ONLY. BOTH TYPES OF MEASUREMENT WERE SENSITIVE TO PERFORMANCE DIFFERENCES BETWEEN THE INDEPENDENT AND COMBINED MODELS AND TO DIFFERENCE AS A RESULT OF AN INCREASED LEVEL OF ALCOHOL INTOXICATION. HOWEVER, THE LRL (LONG RESPONSE LATENCY) VARIABLE WAS ALSO CONSISTENTLY SENSITIVE TO STIMULUS COMPLEXITY WHILE THE SRL (SHORT RESPONSE LATENCY) VARIABLE WAS NOT.

by DENNIS A. ATTWOOD  
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P11-20 (1978)  
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HS-023 227

**AUTOMOBILE SEAT BELT USE IN SELECTED COUNTRIES, STATES AND PROVINCES WITH AND WITHOUT LAWS REQUIRING BELT USE [AUSTRALIA, CANADA, JAPAN, NEW ZEALAND, U.S.]**

SEATBELT USAGE IN AUTOMOBILES WAS OBSERVED IN 19 CITIES IN FIVE COUNTRIES (AUSTRALIA, CANADA, JAPAN, NEW ZEALAND, AND THE U.S.) WHICH HAVE VARYING SEATBELT USE LEGISLATION. IN JURISDICTIONS WITH BELT USE LAWS, USAGE RANGED FROM A HIGH OF 83% IN SYDNEY, AUSTRALIA TO A LOW OF LESS THAN 1% AT EXPRESSWAY EXITS IN JAPAN. PRIOR TO THE COMPULSORY SEATBELT LEGISLATION IN ONTARIO AND QUEBEC, CANADA (SHOULDER BELT, BUT NOT LAP BELT, USE EXEMPTED IN PRE-1974 CARS) AND FOR THE U.S. (DATA FOR BALTIMORE, DETROIT, HOUSTON, AND LOS ANGELES IN THIS STUDY) WITH NO SEATBELT LAWS, BELT USE RANGED FROM A HIGH OF 33% IN LOS ANGELES TO A LOW OF 4% IN WINDSOR, ONTARIO. PERSONS LESS THAN 20 YEARS OF AGE WERE FOUND TO USE BELTS LESS OFTEN THAN ADULTS, AND MANY PEOPLE WERE FOUND TO WEAR THEIR BELTS TOO LOOSELY TO BE EFFECTIVE IN CRASHES. THE 10%-20% REDUCTION IN DEATHS IN COUNTRIES WITH BELT LAWS IS NOT AS HIGH AS WOULD BE EXPECTED, APPARENTLY BECAUSE OF THE LOWER USAGE BY THOSE DISPROPORTIONATELY INVOLVED IN SEVERE CRASHES (E.G. TEENAGERS) AND BECAUSE OF IMPROPER WEARING OF BELTS

by LEON S. ROBERTSON  
Publ: ACCIDENT ANALYSIS AND PREVENTION V10 N1  
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HS-023 228

**FACTORS RELATED TO HEAD INJURY SEVERITY OF MOTORCYCLISTS INVOLVED IN TRAFFIC CRASHES**

A GROUP OF 220 MOTORCYCLE ACCIDENTS OCCURRED IN UTAH DURING 1975 CATEGORIZED ACCORDING TO THE HEAD IN SEVERITY OF MOTORCYCLISTS INVOLVED, STEPWISE DISCRIMINANT ANALYSIS WAS APPLIED TO THE RESULTING CATEGORIES TO DETERMINE FACTORS RELATED TO HEAD INJURY SEVERITY. THE 220 CRASHES STUDIED, 171 (79%) RESULTED IN NO HEAD INJURIES TO THE MOTORCYCLISTS, 1 RESULTED IN MODERATE HEAD INJURY, AND 13% RESULTED IN SEVERE OR FATAL INJURY. SPEED WAS DETERMINED TO BE THE MOST IMPORTANT FACTOR RELATED TO THE SEVERITY OF HEAD INJURY. OF THE NINE VARIABLES NEEDING TO DIFFERENTIATE AMONG HEAD INJURY SEVERITY CATEGORIES, FOUR ARE DIRECT OR INDIRECT INDICATORS OF SPEED (ESTIMATED IMPACT SPEED, CONTRIBUTING CIRCUMSTANCES SPEEDING, SPEED LIMIT, AND TRAVEL SPEED). TWO OF THE VARIABLES USED (VIOLATIONS CHARGED AND REAR MIRRORS) HAVE NOT BEEN EXPLAINED. TWO VARIABLES (EYE PROTECTION INTACT AND HEAD DAMAGE) ARE INDICATORS OF IMPACT SEVERITY. THE NINTH VARIABLE, ADVERSE SURFACE CONDITIONS, IS NEGATIVELY RELATED TO HEAD INJURY SEVERITY; THIS IS PROBABLY BECAUSE SUCH CONDITIONS WOULD ALLOW A MOTORCYCLIST TO SLOW UPON IMPACT, RATHER THAN ABSORBING MOST OF THE FORCE OF THE IMPACT WITH HIS/HER BODY SUCH AS ON DRY PAVEMENT. THE ANALYSIS OF THE SAMPLE MOTORCYCLE CRASHES DID SHOW THAT THE USE OF PROTECTIVE HEADGEAR WAS SIGNIFICANTLY CORRELATED TO HEAD INJURY SEVERITY. EVIDENTLY, SPEED REDUCES THE EFFECT OF HELMET USE; THAT IS, AT THE HIGHEST IMPACT SPEEDS, SEVERE HEAD INJURIES ARE LIKELY TO OCCUR TO A MOTORCYCLIST REGARDLESS WHETHER OR NOT HE/SHE IS WEARING A HELMET

by ROY N. BYRD; ROBERT F. PARENTI  
Publ: ACCIDENT ANALYSIS AND PREVENTION V10 N1  
P1-4 (1978)  
1978; 8REFS

Availability: SEE PUBLICATION

HS-023 229

**ILLUMINATION VS. GLARE: THE 'CATCH-22' OF SAFE HEADLIGHTING**

A BRIEF REVIEW OF RESEARCH ON AMERICAN AND EUROPEAN VEHICLE HEADLIGHTING SYSTEMS DISCUSSES THE MAJOR ISSUES IN HEADLIGHT DESIGN, INCLUDING WHY NO CONSENSUS HAS BEEN REACHED ON A SINGLE "SAFE" HEADLIGHTING SYSTEM. AMERICAN AND EUROPEAN HEADLAMPS DIFFER IN THEIR DESIGN AND THE KIND OF BEAMS THEY PRODUCE. SINCE AMERICAN HEADLAMPS HAVE BEEN MADE AS SEALED UNITS; THAT IS, THE LIGHT SOURCE, REFLECTOR, AND LENS ELEMENTS ARE MANUFACTURED JOINED TO MAKE A SEALED UNIT

November 30, 1978

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CONTRAST, EUROPEAN HEADLAMPS ARE MANUFACTURED AS A COMPOSITE, SO THAT THE LIGHT BULB AND OTHER ELEMENTS ARE SEPARATELY REPLACEABLE. BOTH DESIGNS HAVE THEIR ADVANTAGES AND DISADVANTAGES. THE SEALED BEAM UNIT PREVENTS DIRT AND MOISTURE FROM ENTERING IT AND LOWERING ITS PERFORMANCE OVER TIME. IT CAN ALSO BE RE-AIMED WITH A MECHANICAL RE-AIMING DEVICE. THE EUROPEAN HEADLAMP CANNOT BE MECHANICALLY RE-AIMED BECAUSE OF THE WAY THE BULB RECEPTOR AND THE REFLECTOR ARE MANUFACTURED. AN ADVANTAGE CLAIMED FOR THE EUROPEAN COMPOSITE HEADLAMP IS THAT A BURNT-OUT BULB CAN BE REPLACED; IT IS NOT NECESSARY TO THROW AWAY A GOOD LENS-REFLECTOR UNIT JUST BECAUSE THE LIGHT BULB HAS BURNED OUT. WITH RESPECT TO BEAM INTENSITY, THE LEGAL LIMIT IN THE U.S. FOR A HOTSPOT PRODUCED BY TWO HIGH-BEAM HEADLAMPS IS 150,000 CANDELAS; IN EUROPE, THE MAXIMUM INTENSITY IS 300,000 CANDELAS (EXPECTED TO BE LOWERED SOON TO 250,000 CANDELAS). OBVIOUSLY THE MORE POWERFUL HIGH BEAMS PERMITTED IN EUROPE CAN PROVIDE GREATER FORWARD ILLUMINATION FOR NIGHT DRIVING; BUT IF SUCH POWERFUL HEADLAMPS ARE EVEN SLIGHTLY MISAIMED, THEY CAN BLIND ON-COMING MOTORISTS. AMERICAN HEADLAMPS PRODUCE A DISTINCT OVAL HOTSPOT SURROUNDED BY CONCENTRIC AREAS OF PROGRESSIVELY DIMINISHING INTENSITY. IN CONTRAST, EUROPEAN HEADLAMPS HAVE AN ABRUPT TRANSITION FROM AREAS OF HIGH TO LOW INTENSITY. IN GENERAL, EUROPEAN HEADLAMPS PROJECT SUBSTANTIALLY LESS LIGHT ABOVE THE HORIZONTAL ON THE LEFT SIDE OF THE ROAD, ALONG WITH HIGHER LEVELS OF FOREGROUND ILLUMINATION. RESEARCH STUDIES (SUMMARIES OF MOST IMPORTANT ONES SINCE THE 1950'S TABULATED) TEND TO SHOW THAT THE TWO LOW-BEAM SYSTEMS PERFORM EQUALLY. DISABLING GLARE CAUSED BY MISAIMED HEADLAMPS IS A PROBLEM WITH BOTH SYSTEMS. GIVEN THE PRESENT STATE OF KNOWLEDGE CONCERNING HEADLIGHTING, EUROPEAN HEADLAMPS NEED NOT CONTINUE TO BE BANNED IN THE U.S., BUT NEITHER SHOULD THEY BE PROMOTED AS AN IMPROVEMENT OVER U.S. SEALED BEAM HEADLAMPS.

by PAUL L. OLSON  
Publ: HSRI RESEARCH REVIEW V8 N4 (JAN-FEB 1978)  
1978; 19P  
BASED ON UM-HSRI-77-55 "THE RELATIVE MERITS OF  
DIFFERENT LOW-BEAM HEADLIGHTING SYSTEMS."  
Availability: SEE PUBLICATION

HS-023 230

#### **SPORTS CARS--THE QUANTITATIVE DIFFERENCE [HISTORY]**

THE EVOLUTION OF SPORTS CARS AND THEIR PERFORMANCE CHARACTERISTICS IN THE LAST 30 YEARS IS TRACED WITH EMPHASIS UPON HOW THEY HAVE CHANGED IN RELATION TO OTHER TYPES OF CARS. THEIR RELEVANCY AS A MODE OF TRANSPORTATION IN THE 1980'S AND 1990'S IS ALSO EXPLORED ON THE BASIS OF PAST AND CURRENT DESIGN AND

CHANGING DRIVING CONDITIONS. SEPARATELY CONSIDERED ARE THE PERIODS 1947-1961 AND 1962-1974. A COMPARISON OF SPORTS CAR PERFORMANCE WITH SEDAN PERFORMANCE (E.G. ACCELERATION, TOP SPEED, BRAKING, FUEL ECONOMY, LATERAL ACCELERATION) FOR THE PERIOD 1967-1971 VS. SIMILAR MODELS OF THE PERIOD 1975-1977 IS TABULATED. TRENDS IN SPORTS CAR DESIGN FOR THE PERIODS 1947-1961, 1962-1974, AND 1975-FUTURE ARE APPENDED, AS WELL AS A DISCUSSION OF THE "ROAD AND TRACK" ROAD TEST FOR VEHICLE PERFORMANCE.

by JOHN DINKEL

ROAD AND TRACK

Rept. No. SAE-770310; 1977; 24P REFS

PRESENTED AT INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 231

#### **ADAMS2: A SPARSE MATRIX APPROACH TO THE DYNAMIC SIMULATION OF TWO-DIMENSIONAL MECHANICAL SYSTEMS [COMPUTER PROGRAM]**

AN EFFICIENT COMPUTER PROGRAM FOR GENERAL PURPOSE DYNAMIC SIMULATION OF TWO-DIMENSIONAL MECHANICAL SYSTEMS, ADAMS2 (AUTOMATIC DYNAMIC ANALYSIS OF MECHANICAL SYSTEMS, 2-DIMENSIONAL), IS DESCRIBED. THIS PROGRAM WAS DEVELOPED ALONG THE SAME LINES AS THE ADAMS PROGRAM FOR SIMULATION OF THREE-DIMENSIONAL MECHANICAL SYSTEMS WHICH WAS DESIGNED TO BE GENERAL AND INCORPORATES MODERN SPARSE MATRIX AND STIFF INTEGRATION TECHNIQUES FOR NUMERICAL EFFICIENCY. IN NUMEROUS APPLICATIONS, THE ADAMS PROGRAM HAS PROVEN TO BE A VERY ACCURATE AND COST-EFFECTIVE SIMULATION SCHEME; AND ALTHOUGH IT CAN DEAL WITH A TWO-DIMENSIONAL SYSTEM BY APPLYING APPROPRIATE CONSTRAINTS TO A THREE-DIMENSIONAL GENERALIZED SYSTEM, EXPERIENCE INDICATES THIS IS NOT A SATISFACTORY APPROACH. THE ADAMS2 PROGRAM IS APPROXIMATELY 75% MORE EFFICIENT THAN ADAMS FOR THE SIMULATION OF TWO-DIMENSIONAL SYSTEMS. THE GENERALITY IS NOT LOST AS LONG AS ADAMS AND ADAMS2 EXIST TOGETHER. ADAMS2 INHERITED ALL THE CHARACTERISTICS OF ADAMS FOR SIMULATION OF HIGHLY NONLINEAR SYSTEMS. FUTURE WORK MUST BE DONE TO INTRODUCE LINEARIZED ANALYSIS AS A FEATURE OF ADAMS2. TWO EXAMPLES OF SYSTEMS SIMULATED WITH ADAMS2, A CLASSIC FOUR BAR LINKAGE AND AN EXCAVATING MECHANISM, ARE DISCUSSED.

by N. ORLANDEA; J. C. WILEY; R. WEHAGE  
DEERE AND CO., TECHNICAL CENTER; UNIVERSITY OF IOWA

Rept. No. SAE-780486; 1978; 12P 6REFS

PRESENTED AT EARTHMOVING INDUSTRY CONFERENCE, PEORIA, ILL., 10-12 APR 1978.

Availability: SAE

HS-023 232

HS-023 232

### **HYDROSTATICS AND PLANETARY GEARING--A SYNERGISTIC APPROACH [EARTHMOVING AND CONSTRUCTION EQUIPMENT TRACK DRIVES]**

A COMBINATION OF HYDROSTATICS AND PLANETARY GEARING AS A SYNERGISTIC MATING OF TWO BASIC MODES OF POWER TRANSMISSION IN MOBILE APPLICATIONS IS REVIEWED WITH PARTICULAR EMPHASIS ON ITS APPLICATION TO TRACK DRIVES FOR THE EARTHMOVING AND CONSTRUCTION INDUSTRIES. COMPACTNESS IS PARTICULARLY IMPORTANT IN APPLICATIONS SUCH AS EARTHMOVING AND CONSTRUCTION EQUIPMENT TRACK DRIVES, WHERE GROUND CLEARANCE IS A PRIME CONSIDERATION. HYDROSTATIC MOTORS ARE CAPABLE OF TRANSMITTING MANY HUNDREDS OF HORSEPOWER PER CUBIC FOOT. FLEXIBILITY IS EVIDENT IN THE ADAPTABILITY OF HYDROSTATIC MOTORS TO MOBILE DRIVE SYSTEMS. PARTIALLY BECAUSE OF THEIR COMPACTNESS, THEY FIT IN WHERE OTHER TRANSMISSION MODES WILL NOT. FLEXIBLE HYDRAULIC LINES PRECLUDE THE NEED FOR PRECISE CONTROL OVER PRIME MOVER/OUTPUT PHYSICAL LOCATION AND ORIENTATION. PLANETARY FINAL DRIVE SYSTEMS OFFER MANY ADVANTAGES OVER CHAIN AND SPROCKET AND/OR SPUR GEAR DRIVES, THE PRIMARY ADVANTAGE BEING THE MUCH BETTER LOAD DISTRIBUTION THAT IS OBTAINED, WHICH ALLOWS FOR AN OVERALL PHYSICAL SIZE REDUCTION. THIS SYNERGISTIC APPROACH OF HYDROSTATIC SYSTEM AND PLANETARY GEARING OFFERS MANUFACTURERS OF TRACK-LAYING EQUIPMENT THE OPTIMUM SYSTEM. BOTH SYSTEMS OFFER HIGHLY EFFICIENT, TOTALLY ENCLOSED COMPONENTS WITH A HIGH DEGREE OF FLEXIBILITY IN THE ARCHITECTURAL DESIGN OF THE VEHICLE. OTHER ADVANTAGES WOULD BE THE ELIMINATION OF ALL MECHANICAL TRANSMISSION PARTS AND ANY MECHANICAL CONNECTIONS TO THE TRACK DRIVE SYSTEM. THE HYDROSTATIC/PLANETARY DRIVE SYSTEM HAS INFINITELY VARIABLE SPEED, INSTANT REVERSIBILITY, AND ONE CONTROL THAT CAN BE UTILIZED TO GOVERN SPEED AND DIRECTION IF SO DESIRED. UTILIZATION OF VARIOUS TRACK DRIVE RATIOS AND HYDRAULIC MOTOR SIZE COMBINATIONS ALLOWS FOR MAXIMUM OPTIMIZATION OF PERFORMANCE CHARACTERISTICS REQUIRED BY THE MANY DIFFERENT TRACK-LAYING VEHICLES.

by HOWARD J. SCULTHORPE; ROBERT E. LEMON  
SPERRY RAND CORP., SPERRY VICKERS DIV.  
Rept. No. SAE-780466; 1978; 8P  
PRESENTED AT EARTHMOVING INDUSTRY  
CONFERENCE, PEORIA, ILL., 10-12 APR 1978.  
Availability: SAE

HS-023 233

### **DAVISORB BUMPERS REDUCE WEIGHT AND DAMAGE [URETHANE]**

THE DAVISORB BUMPER SYSTEM IS A LIGHTWEIGHT AUTOMOTIVE BUMPER UTILIZING REACTION INJECTION MOLDED (RIM) URETHANE FASCIA, MOLDED

HSL 78-11

ENERGY ABSORBERS MADE OF URETHANE FOAM, AND SIMPLE, LOW-WEIGHT SUPPORTING STRUCTURES. AN ENGINEERED URETHANE FOAM ENERGY ABSORBER IS LOCATED DIRECTLY UNDER THE URETHANE FASCIA AND IS MOUNTED TO A BEAM OR STRUCTURE WHICH IS RIGIDLY ATTACHED TO THE VEHICLE. UNDER IMPACT, THE FASCIA DEFLECTS WHICH ALLOWS THE FOAM ABSORBER TO COMPRESS BETWEEN THE IMPACTING DEVICE AND THE SUPPORTING VEHICLE STRUCTURE. AFTER IMPACT, THE FASCIA AND ENERGY ABSORBER RECOVER THEIR ORIGINAL SHAPE AND POSITION. THE FOLLOWING TYPES OF SOFT BUMPER ARE AVAILABLE: BLADE TYPE WHICH DIRECTLY REPLACES AN EXISTING METAL SYSTEM; PARTIAL FASCIA TYPE WHICH INTEGRATES ADJACENT BODY COMPONENTS SUCH AS THE LOWER VALANCE; AND THE FULL FASCIA TYPE WHICH HAS A COVER ENCOMPASSING THE ENTIRE FRONT OR REAR BODY END PANEL IN A SINGLE FLEXIBLE SYSTEM. SOFT BUMPERS CAN MEET THE NEW DAMAGE LIMIT REQUIREMENT OF FEDERAL MOTOR VEHICLE SAFETY STANDARD PART 581 WITHOUT MODIFICATION. WEIGHT SAVINGS ARE CONSIDERABLE, DUE PRINCIPALLY TO THE STRUCTURE REQUIRED TO SUPPORT IT. THE BEAM CAN BE ELIMINATED WITH THE DEEP FOAM SUPPORTED DIRECTLY ON BODY END PANEL SHEET METAL. IMPACTS AT SPEEDS UP TO 5 MPH CAN BE SUSTAINED WITHOUT DETECTABLE DAMAGE. DETAILS OF ENERGY MANAGEMENT AND DESIGN ARE GIVEN. THE DAVISORB S/L SYSTEM HAS BEEN PROTOTYPED IN THE FRONT BUMPER SYSTEM OF THE CALSPAN/CHRYSLER RESEARCH SAFETY VEHICLE.

by PETER A. WELLER; JERRY V. SCRIVO  
DAVIDSON RUBBER CO., INC.

Rept. No. SAE-770308; 1977; 14P 8REFS  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 234

### **NEW 6XXX-SERIES ALLOYS FOR AUTO BODY SHEET [ALUMINUM]**

TWO NEW ALUMINUM ALLOYS OF THE AL-MG-SI (ALUMINUM-MAGNESIUM-SILICON) SYSTEM, 6009 AND 6010, FOR AUTO BODY SHEET ARE DESCRIBED AND TECHNICAL DATA PRESENTED. THE 6XXX-SERIES ALLOYS ARE IDEAL FOR BODY SHEET IN THAT THEY PROVIDE EXCELLENT CORROSION RESISTANCE, IMPROVED SPOT WELDABILITY, AND FREEDOM FROM LUDER'S LINES, TOGETHER WITH FAVORABLE RESPONSE TO AGING IN MANY PAINT BAKE CYCLES. THE RESULT IS A COMBINATION OF EXCELLENT FORMABILITY IN THE T4 TEMPER AND, AFTER AGING, HIGHER STRENGTH THAN ACHIEVABLE IN ANY OTHER ALUMINUM ALLOY SYSTEM HAVING OTHER CHARACTERISTICS DESIRED IN BODY SHEET. THE LATTER FEATURE TRANSLATES TO EXCELLENT DENT RESISTANCE, SUPERIOR EVEN TO THAT OF STEEL. FURTHERMORE, SCRAP LOOP PROBLEMS ARE ELIMINATED; COMPATIBLE ALLOYS 6009 AND 6010 MAY BE USED TOGETHER TO OBTAIN OPTIMUM STRENGTH AND FORMABILITY WITHOUT

November 30, 1978

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PENALTIES IN SCRAP UTILIZATION. FORMING, AGING, FINISHING, AND JOINING DATA ARE PRESENTED FOR THESE ALLOYS.

by J. W. EVANCHO; J. G. KAUFMAN  
ALUMINUM CO. OF AMERICA  
Rept. No. SAE-770307; 1977; 11P  
PRESENTED AT INTERNATIONAL AUTOMOTIVE  
ENGINEERING CONGRESS AND EXPOSITION,  
DETROIT, 28 FEB-4 MAR 1977.

Availability: SAE

HS-023 235

#### BRAKE JOB INSURANCE

IN INSPECTING AND SERVICING FRONT-DISC BRAKES, IT IS SUGGESTED THAT THE MECHANIC EXAMINE OTHER COMPONENTS OF THE BRAKE SYSTEM IN ADDITION TO THE BRAKE PADS. ON MOST CARS, REMOVING THE WHEEL WILL EXPOSE ENOUGH OF THE BRAKE PAD TO DETERMINE IF REPLACEMENT IS NEEDED. AN EXPERIENCED MECHANIC CAN REPLACE A SET OF PADS IN MINUTES AND ALL TOO OFTEN THAT IS ABOUT ALL THAT IS DONE. THIS IS, IN A SENSE, A BAD FEATURE ABOUT DISC BRAKES; A MECHANIC NEED NEVER TOUCH THE FRONT-WHEEL BEARINGS WHILE PERFORMING WHAT MAY INACCURATELY BE CALLED A "COMPLETE BRAKE JOB." MOST AUTO MANUFACTURERS AGREE THAT WHEEL BEARINGS SHOULD BE CHECKED AND REPACKED WHEN BRAKE PADS ARE REPLACED. THE FACT IS THAT RETAINERS AND BEARINGS DO WEAR OUT. THE TIME OF BRAKE PAD REPLACEMENT IS PROBABLY THE ONLY OPPORTUNITY A MECHANIC WILL HAVE TO CHECK THEM. THE MECHANIC WHO IGNORES THIS CHANCE IS DOING HIMSELF/HERSELF AND HIS/HER CUSTOMERS A GREAT DISSERVICE. WHENEVER BRAKE PADS ARE REPLACED, EVEN IF THE ROTOR IS NOT GOING TO BE TRUED, FRONT BEARINGS AND GREASE RETAINERS SHOULD BE INSPECTED; BEARINGS CLEANED, CAREFULLY CHECKED, AND PROPERLY REPACKED; AND NEW GREASE RETAINERS INSTALLED. INSTRUCTIONS FOR INSPECTING AND SERVICING WHEEL BEARINGS AND GREASE RETAINERS ARE PROVIDED.

by BOB CERULLO  
Publ: MOTOR V148 N5 P44-6, 66 (NOV 1977)

1977  
Availability: SEE PUBLICATION

HS-023 236

#### ALTERNATIVE FUELS FOR AUTOMOTIVE TRANSPORTATION - A FEASIBILITY STUDY. FINAL REPORT. VOL. 3 - APPENDICES

PROPERTIES ARE TABULATED OF EIGHTEEN ALTERNATIVE FUELS FOR AUTOMOTIVE TRANSPORTATION, INCLUDING ACETYLENE, AMMONIA, CARBON MONOXIDE, COAL, DIESEL OIL, ETHANOL, FUEL OIL, GASOLINE, HYDRAZINE, AND HYDROGEN, AS WELL AS KEROSENE, METHANE, METHANOL, METHYLAMINE, NAPHTHA, PROPANE, LPG (LIQUIFIED PROPANE GAS), AND VEGETABLE

(COTTONSEED) OIL. DETAILED PROCESS DESCRIPTIONS AND ECONOMICS ARE PRESENTED FOR CANDIDATE FUELS FROM COAL AND OIL SHALE. AMONG THE PROCESSES DESCRIBED ARE CSF PROCESS (CONSOL SYNTHETIC FUEL) AND THE GAS COMBUSTION PROCESS FOR GASOLINE AND DISTILLATE FUELS, KOPPERS-TOTZEK GASIFIER AND ICI SYNTHESIS FOR METHANOL, AND SNG (SYNTHETIC NATURAL GAS) FROM COAL.

by J. PANGBORN; J. GILLIS  
INSTITUTE OF GAS TECHNOLOGY, CHICAGO, ILL.  
60616  
EPA-68-01-2111  
Rept. No. EPA-460/3-74-012-C; PB-276 793; 1974; 116P  
35REFS  
VOL. 1 (EXECUTIVE SUMMARY) IS HS-022 643; V2  
(TECHNICAL SECTION) IS HS-022 644.  
Availability: NTIS

HS-023 237

#### HOW TO KEEP THE CORK ON AUTO RATES (INSURANCE, ENFORCEMENT)

RISING AUTOMOBILE INSURANCE PREMIUMS ARE CAUSING PUBLIC CONCERN. IF CLAIMS COSTS ARE TO BE REDUCED THERE HAS TO BE A REDUCTION IN CLAIMS FREQUENCY. ENLIGHTENED TRAFFIC REGULATION AND STRICT ENFORCEMENT OF TRAFFIC LAWS SAVE DOLLARS IN LIVES, PROPERTY, AND INSURANCE. WHEN THE 55 MPH SPEED LIMIT WAS INTRODUCED THERE WAS AN IMMEDIATE REDUCTION IN HIGHWAY DEATHS AND INJURIES. THE STRICT LAW ENFORCEMENT IN OUACHITA PARISH (COUNTY), LA., INCLUDING PROSECUTION FOR DRINKING WHILE INTOXICATED, HAS RESULTED IN ONE OF THE LOWEST PRIVATE PASSENGER AUTOMOBILE LIABILITY INSURANCE RATES IN THAT STATE. PUBLIC PRESSURES MAKE STRICT ENFORCEMENT DIFFICULT, BUT ENFORCEMENT IS HELPED WHEN LOCAL NEWSPAPERS SUPPORT THE NO-NONSENSE TRAFFIC ENFORCEMENT, AS IS THE CASE IN OUACHITA PARISH. CITIES SHOULD BE GRADED ON LAW ENFORCEMENT AS MUNICIPALITIES HAVE BEEN GRADED ON FIRE PROTECTION, TO ENCOURAGE COMMUNITIES TO BE MORE CONSCIOUS OF THEIR TRAFFIC LAW ENFORCEMENT RECORD.

by CHARLES E. MCKENZIE, JR.  
Publ: JOURNAL OF INSURANCE V39 N3 P28-30  
(MAY/JUN 1978)  
1978  
Availability: SEE PUBLICATION

HS-023 240

#### AD HOC STUDY OF CERTAIN SAFETY-RELATED ASPECTS OF DOUBLE-BOTTOM TANKERS. FINAL REPORT

AN EXAMINATION OF THE STABILITY OF MICHIGAN DOUBLE TANKERS RELATIVE TO OTHER FUEL-HAULING VEHICLES IS PRESENTED, IN LIGHT OF CONCERN OVER THE NUMBER OF ACCIDENTS OF FUEL-CARRYING "DOUBLE-BOTTOM" TANKERS. A MEANS FOR MODIFYING DOUBLE TANKERS TO IMPROVE DYNAMIC STABILITY IS DEVELOPED AND

DEMONSTRATED IN FULL-SCALE TESTS. THE MICHIGAN BASELINE DOUBLE-BOTTOM TANKER IS EXCEPTIONALLY LOW IN DYNAMIC ROLLOVER STABILITY, PARTICULARLY IN ACCIDENT-EVASION MANEUVERS. THE INSTABILITY ACCOUNTS FOR A PREPONDERANCE OF THE ACCIDENTS IN WHICH THE PUP TRAILER ROLLED OVER ALONE LEAVING THE TRACTOR-SEMITRAILER STILL STANDING. THE BASELINE DOUBLE CAN BE MODIFIED TO YIELD A TWOFOLD IMPROVEMENT IN ITS ROLLOVER STABILITY LEVEL BY INSTALLING, BETWEEN THE DOLLY AND SEMITRAILER, A HITCH, RIGID IN BOTH STEER AND ROLL DIRECTION, AND BY INSTALLING DEVICES IN THE SUSPENSIONS TO ELIMINATE EXCESSIVE CLEARANCE IN THE LEAF SPRING CONSTRAINTS. THE MODIFIED DOUBLE-BOTTOM TANKER EXHIBITS A ROLLOVER STABILITY LEVEL COMPARABLE TO THAT OF THE SHORT MICHIGAN TANKER, BUT HAS SLIGHTLY LESS MANEUVERABILITY THAN THE BASELINE DOUBLE. THE PUP TRAILER OF THE BASELINE DOUBLE HAS A LIGHTLY-DAMPED MODE OF YAW OSCILLATION WHICH CAN BECOME UNSTABLE IF ONLY THE REAR COMPARTMENT OF THE PUP TRAILER IS LOADED AND SPEED EXCEEDS 50 MPH. OPERATION OF FUEL TANKERS WITH ANY COMPARTMENTS ONLY PARTIALLY FILLED RISKS A REDUCTION IN THE ROLLOVER THRESHOLD. THE SUSPENSION FEATURE INVOLVING FREE PLAY IN THE VERTICAL LOCATION OF SUSPENSION LEAF SPRINGS CAN REDUCE THE DYNAMIC ROLLOVER THRESHOLD BY AS MUCH AS 15%. THE COMPROMISING FEATURE CAN BE ALMOST ELIMINATED WITH A MINOR MODIFICATION. THE DELIVERY OF FUEL USING SHORT MICHIGAN SINGLE TANKERS PROBABLY YIELDS THE HIGHEST EXPOSURE OF TRAFFIC TO FIRE HAZARD OF ALL KNOWN FLEET OPTIONS, EXCLUDING THE UNMODIFIED DOUBLE-BOTTOM TANKER. RECOMMENDATIONS ARE AS FOLLOWS: USE OF THE PRESENT MICHIGAN DOUBLE TANKER SHOULD BE DISCONTINUED, AND ITS MODIFIED VERSION USED IN THE NEAR TERM; WIDE USE OF THE SHORT MICHIGAN SINGLE SHOULD BE DISCOURAGED, IF NOT PREVENTED; AND PARTIAL LOADING OF ALL TANKERS SHOULD BE DISCOURAGED. ANY POLICIES AFFECTING A CHANGE IN MAKEUP OF MICHIGAN'S TANKER FLEET SHOULD ACCOUNT FOR CHANGES IN TOTAL EXPOSURE OF TRAFFIC TO FIRE HAZARD. CONSIDERABLE IMPROVEMENT IN DIRECTIONAL AND ROLLOVER PERFORMANCE OF TANKER VEHICLES CAN BE MADE.

by R. D. ERVIN; P. S. FANCHER; T. D. GILLESPIE; C. B. WINKLER; A. WOLFE  
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INST., HURON PKWY. AND BAXTER RD., ANN ARBOR,  
MICH. 48109  
MPA-78-002A

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REPT. FOR 14 NOV 1977-7 MAY 1978. SPONSORED BY  
MICHIGAN DEPT. OF STATE POLICE, OFFICE OF HWY.  
SAFETY PLANNING. HS-023 404 CONTAINS  
APPENDICES.

Availability: CORPORATE AUTHOR

#### POLICY PERSPECTIVES AND UNDERWRITING INFORMATION TECHNIQUES--PERSONAL AUTOMOBILE INSURANCE

EXECUTIVES WERE INTERVIEWED AND OTHER PERSONNEL SURVEYED TO IDENTIFY SOME OF THE MAJOR PROBLEMS AND ISSUES IN PERSONAL AUTO INSURANCE COVERAGE, PARTICULARLY THEIR IMPACT ON UNDERWRITING PRACTICES. EXECUTIVES CONCLUDED THAT THE RIGHT TO DRIVE A MOTOR VEHICLE AND TO BE PROTECTED AGAINST FINANCIAL LOSS RESULTING FROM ITS OPERATION WERE PERCEIVED AS AN INALIENABLE RIGHT; THAT THE PRIVATE ENTERPRISE SYSTEM WOULD CONTINUE; THAT COMPULSORY COVERAGE AND PARTICIPATION IN THE UNDERWRITING PROCESS THROUGH AUTOMOBILE INSURANCE PLANS, ASSIGNED RISK POOLS, ETC. WOULD CONTINUE; AND THAT THERE WOULD BE NO SIGNIFICANT CHANGES IN THE FORM OF COVERAGE. EXECUTIVES BELIEVED THAT THE MARKET WOULD CONTINUE TO EXPAND BY NUMBER OF UNITS AND PREMIUM INCOME; MARKET SHARES HELD BY DIRECT WRITERS AND AGENCY COMPANIES WERE EXPECTED TO REMAIN THE SAME. THE PROPORTION OF INCOME ALLOCATED TO PURE LOSS WAS EXPECTED TO INCREASE, AND THAT TO SERVICE TO DECLINE, WITH CENTRALIZATION AND COMPUTERIZATION OF SERVICES. TARGET MARKET UNDERWRITING AND STATISTICAL UNDERWRITING WERE EXPECTED TO INCREASE AS REGULATIONS ON INDIVIDUAL UNDERWRITING ARE DEVELOPED. THERE IS A DEVELOPING MARKET FOR INFORMATION SERVICES TO PROVIDE NEW AND CHEAPER TECHNIQUES OF APPLICANT CONTACT AND INFORMATION DEVELOPMENT, INTERFACE WITH THE STATE FOR MOTOR VEHICLE RECORDS, ACCESS TO BUREAU REPORTS ON CLAIMS, AND PHYSICAL PROPERTY VERIFICATIONS. THE MAIL SURVEY OF UNDERWRITERS INDICATED THAT THERE ARE A LARGE NUMBER OF FACTORS CONSIDERED IMPORTANT IN THEIR DECISIONS -- LAW VIOLATIONS, ACCIDENTS AND LOSSES, AUTOMOBILE INFORMATION AND PERSONAL CHARACTERISTICS OF DRIVERS. THERE WAS NOTICEABLE VARIATION AMONG RESPONDENTS ON THE USEFULNESS OF INVESTIGATIVE REPORTS; THEY WERE CONSIDERED MOST USEFUL IN DRINK AND DRUG HABITS AND LAW VIOLATIONS, WERE JUDGED OF AVERAGE VALUE FOR ACCIDENTS AND LOSSES, SOME PERSONAL FACTORS, AUTO INFORMATION AND YOUTHFUL OPERATORS. RATING FACTORS WERE MORE HIGHLY RANKED THAN NON-RATING FACTORS. IN GENERAL, UNDERWRITERS FROM MUTUAL ORGANIZATIONS RANK ALL FACTORS HIGHER IN IMPORTANCE AND OBTAIN MORE INFORMATION THAN DO UNDERWRITERS FROM STOCK ORGANIZATIONS. DIRECT WRITERS AND EXCLUSIVE AGENCY UNDERWRITERS PLACE MORE EMPHASIS THAN INDEPENDENTS ON THE IMPORTANCE OF ACCIDENTS AND LOSSES, LAW VIOLATIONS AND AUTOMOBILE INFORMATION, BUT LESS EMPHASIS ON PERSONAL AND YOUTHFUL OPERATOR INFORMATION. SMALL COMPANIES ASSIGN HIGHER FACTOR IMPORTANCE RANKINGS THAN LARGE COMPANIES, WITH LARGE COMPANIES OBTAINING MORE INFORMATION THAN SMALL COMPANIES EXCEPT IN EMPLOYMENT AND

PERSONAL INFORMATION CATEGORIES. SMALL COMPANIES RANK INVESTIGATIVE REPORTS AS MORE USEFUL THAN DO LARGER ONES. MANY COMPANIES NOW USE DIFFERENT INFORMATION SOURCES, AND EVALUATION METHODS IN PERSONAL LINES UNDERWRITING. CLASSIFICATION, RATING AND SELECTION CRITERIA ON A BROAD IMPERSONAL BASIS MAY BE SUCCESSFUL IN DEALING WITH PRESENT PROBLEMS AND SOME DATA MAY BE USED AS PROXY FOR OTHER IN MAKING CLASS AND RATE DECISIONS. OBTAINING AND PROMOTING THE USE OF STATISTICALLY CREDIBLE INFORMATION IS A PROBLEM. THE INFORMATION REPORTING INDUSTRY HAS BEEN CIRCUMSCRIBED RADICALLY BY REGULATION. A NEW APPROACH INVOLVING DIRECT PERSONAL INTERVIEW AND RECORD VERIFICATION FOR PERSONAL FACTORS, PROPERTY INSPECTION AND BUREAU REPORTS, ALL OF WHICH ARE SELF-VERIFYING, WOULD PROVIDE A NEEDED INFORMATION SERVICE.

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78; 169P  
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PROPERTY/CASUALTY DIV., P.O. BOX 4081, ATLANTA,  
A. 30302 \$10.00

S-023 242

#### PREDICTION OF VEHICLE REFERENCE FRONTAL AREA

BEGINNING WITH THE 1979 MODEL YEAR, THE DYNAOMETER POWER ABSORPTION TO SIMULATE THE VEHICLE ROAD LOAD DURING EXHAUST EMISSION CERTIFICATION TESTING AND FUEL ECONOMY MEASUREMENTS WILL BE PREDICTED BY THE VEHICLE FRONTAL AREA, DEFINED AS THE AREA OF ORTHOGONAL PROJECTION OF THE VEHICLE ONTO A PLANE PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE VEHICLE. THE DETERMINATION OF THIS AREA BY ANALYSIS OF ENGINEERING DRAWINGS, PROJECTION TECHNIQUES FROM THE ACTUAL VEHICLE, OR PLANIMETER MEASUREMENTS FROM PHOTOGRAPHS, IS ACCURATE BUT TIME-CONSUMING. AN EQUATION TO ESTIMATE THE VEHICLE REFERENCE FRONTAL AREA USING THE OVERALL VEHICLE HEIGHT AND WIDTH IS DEVELOPED, USING THE REFERENCE AREA DATA AND THE OVERALL HEIGHT AND WIDTH DATA SUPPLIED BY VEHICLE MANUFACTURERS. THE PRODUCT OF THE OVERALL HEIGHT, WIDTH, AND THE COEFFICIENT, 0.80, YIELDS A GOOD APPROXIMATION OF THE ACTUAL VEHICLE REFERENCE FRONTAL AREA. USING THIS APPROXIMATION, THERE IS 80% CONFIDENCE THAT THE PREDICTED VALUE WILL BE WITHIN PLUS OR MINUS 1.0 SQ FT OF THE ACTUAL REFERENCE FRONTAL AREA. THIS APPROXIMATELY 5% OF THE REFERENCE AREA OF A TYPICAL VEHICLE. THIS EQUATION IS RECOMMENDED AS A METHOD FOR EVALUATION OF SUBMITTED REFERENCE AREA DATA OR FOR PREDICTING VEHICLE REFERENCE FRONTAL AREAS WHEN EMPIRICAL DATA ARE NOT AVAILABLE. USE OF THE PREDICTED EQUATION IN THE REGULATORY

PROCESS IS NOT RECOMMENDED BECAUSE OF THE INACCURACIES IN THE CASE OF ATYPICAL VEHICLES. ALSO, IF THE PRODUCT OF THE OVERALL HEIGHT AND WIDTH WERE USED IN THE REGULATORY PROCESS, MANUFACTURERS MIGHT TEND TO PRODUCE THE LARGEST REFERENCE AREA VEHICLE POSSIBLE WITHIN A GIVEN HEIGHT TIMES WIDTH, THUS IMPOSING DESIGN-ORIENTED PRESSURE. IT IS THE VEHICLE REFERENCE AREA THAT IS THE IMPORTANT PARAMETER, NOT THE VEHICLE HEIGHT OR WIDTH.

by HARRIET W. GOODALL; GLENN D. THOMPSON  
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STANDARDS DEVEL. AND SUPPORT BRANCH, ANN  
ARBOR, MICH.

Rept. No. PB-276 541; LDTP-77-7; 1977; 14P 2REFS  
TECHNICAL SUPPORT REPT. FOR REGULATORY  
ACTION.

Availability: NTIS

HS-023 243

#### A FOUNDATION FOR SYSTEMS ANTHROPOMETRY. PHASE 2. FINAL REPORT

THE EXPERIMENTAL PROCEDURES USED IN AN INVESTIGATION OF THE LANDMARKS, AXES SYSTEMS, AND JOINT PROPERTIES NECESSARY TO DESCRIBE THE HUMAN BODY IN THREE-DIMENSIONAL SPACE ARE DESCRIBED. THREE FRESH CADAVERS WERE USED TO STUDY THE SPATIAL RELATIONSHIP BETWEEN INTERNAL AND EXTERNAL LANDMARKS IN THE LUMBAR/PELVIC/FEMUR REGION OF THE BODY, AS WELL AS THE MOTION CHARACTERISTICS OF THE HIP JOINT IN FLEXION-EXTENSION, ABDUCTION-ADDITION, AND INTERNAL-EXTERNAL ROTATION. THE CIVIL AEROMEDICAL INST.'S STUDY USED 150 MALE AND 150 FEMALE OSTEOLOGICAL SPECIMENS TO INVESTIGATE THE THREE-DIMENSIONAL VARIABILITY OF LANDMARK LOCATIONS IN THE PELVIS. DATA ARE PRESENTED IN TABULAR AND GRAPHICAL FORM. RESULTS TO DATE SHOW THAT BIOLOGICAL VARIABILITY MUST BE CONSIDERED AS A SET OF PROBABILISTIC PHENOMENA IN DETERMINISTIC BIOMECHANICAL MODELS, THAT BODY POSITION AND MOBILITY MUST BE CONSIDERED SIMULTANEOUSLY IN THREE-DIMENSIONAL SPACE, THAT DATA COLLECTION AND ANALYSIS MUST INCORPORATE THE USE OF ANATOMICAL FRAMES OF REFERENCE DEFINED BY FUNCTIONALLY SIGNIFICANT LANDMARKS IN THE SKELETAL SYSTEM, AND THAT BODY POSITION CAN BE DEFINED BY THE LOCATION OF ANATOMICAL FRAMES OF REFERENCE, AND BODY MOBILITY CAN BE DEFINED BY RELATIVE MOTION BETWEEN ADJACENT ANATOMICAL FRAMES OF REFERENCE.

by HERBERT M. REYNOLDS; JAMES R. FREEMAN;  
MAX BENDER  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
INST., ANN ARBOR, MICH. 48109

F44620-76-C-0115  
Rept. No. UM-HSRI-78-11; 1978; 97P 4REFS  
REPT. FOR 1 DEC 1976-30 SEP 1977.

Availability: CORPORATE AUTHOR

Demonstrated in full-scale tests. The Michigan Baseline Double-Bottom Tanker is exceptionally low in dynamic rollover stability, particularly in accident-evasion maneuvers. The instability accounts for a preponderance of the accidents in which the pup trailer rolled over alone leaving the tractor-semitrailer still standing. The Baseline Double can be modified to yield a twofold improvement in its rollover stability level by installing, between the dolly and semitrailer, a hitch, rigid in both steer and roll direction, and by installing devices in the suspensions to eliminate excessive clearance in the leaf spring constraints. The modified Double-Bottom Tanker exhibits a rollover stability level comparable to that of the short Michigan Tanker, but has slightly less maneuverability than the Baseline Double. The pup trailer of the Baseline Double has a lightly-damped mode of yaw oscillation which can become unstable if only the rear compartment of the pup trailer is loaded and speed exceeds 50 mph. Operation of fuel tankers with any compartments only partially filled risks a reduction in the rollover threshold. The suspension feature involving free play in the vertical location of suspension leaf springs can reduce the dynamic rollover threshold by as much as 15%. The compromising feature can be almost eliminated with a minor modification. The delivery of fuel using short Michigan single tankers probably yields the highest exposure of traffic to fire hazard of all known fleet options, excluding the unmodified Double-Bottom Tanker. Recommendations are as follows: use of the present Michigan Double Tanker should be discontinued, and its modified version used in the near term; wide use of the short Michigan Single should be discouraged, if not prevented; and partial loading of all tankers should be discouraged. Any policies affecting a change in makeup of Michigan's tanker fleet should account for changes in total exposure of traffic to fire hazard. Considerable improvement in directional and rollover performance of tanker vehicles can be made.

by R. D. ERVIN; P. S. FANCHER; T. D. GILLESPIE; C. B. WINKLER; A. WOLFE  
 UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
 INST., HURON PKWY. AND BAXTER RD., ANN ARBOR,  
 MICH. 48109  
 MPA-78-002A  
 Rept. No. UM-HSRI-78-18-1; 1978; 77P 8REFS  
 REPT. FOR 14 NOV 1977-7 MAY 1978. SPONSORED BY  
 MICHIGAN DEPT. OF STATE POLICE, OFFICE OF HWY.  
 SAFETY PLANNING. HS-023 404 CONTAINS  
 APPENDICES.  
 Availability: CORPORATE AUTHOR

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 SP  
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### POLICY PERSPECTIVES AND UNDERWRITING INFORMATION TECHNIQUES--PERSONAL AUTOMOBILE INSURANCE

EXECUTIVES WERE INTERVIEWED AND OTHER PERSONNEL SURVEYED TO IDENTIFY SOME OF THE MAJOR PROBLEMS AND ISSUES IN PERSONAL AUTO INSURANCE COVERAGE, PARTICULARLY THEIR IMPACT ON UNDERWRITING PRACTICES. EXECUTIVES CONCLUDED THAT THE RIGHT TO DRIVE A MOTOR VEHICLE AND TO BE PROTECTED AGAINST FINANCIAL LOSS RESULTING FROM ITS OPERATION WERE PERCEIVED AS AN INALIENABLE RIGHT; THAT THE PRIVATE ENTERPRISE SYSTEM WOULD CONTINUE THAT COMPULSORY COVERAGE AND PARTICIPATION IN THE UNDERWRITING PROCESS THROUGH AUTOMOBILE INSURANCE PLANS, ASSIGNED RISK POOLS, ETC. WOULD CONTINUE; AND THAT THERE WOULD BE NO SIGNIFICANT CHANGES IN THE FORM OF COVERAGE. EXECUTIVES BELIEVED THAT THE MARKET WOULD CONTINUE TO EXPAND BY NUMBER OF UNITS AND PREMIUM INCOME; MARKET SHARES HELD BY DIRECT WRITERS AND AGENCY COMPANIES WERE EXPECTED TO REMAIN THE SAME. THE PROPORTION OF INCOME ALLOCATED TO PURE LOSS WAS EXPECTED TO INCREASE, AND THAT TO SERVICE TO DECLINE, WITH CENTRALIZATION AND COMPUTERIZATION OF SERVICES. TARGET MARKET UNDERWRITING AND STATISTICAL UNDERWRITING WERE EXPECTED TO INCREASE AS REGULATIONS ON INDIVIDUAL UNDERWRITING ARE DEVELOPED. THERE IS A DEVELOPING MARKET FOR INFORMATION SERVICES TO PROVIDE NEW AND CHEAPER TECHNIQUES OF APPLICANT CONTACT AND INFORMATION DEVELOPMENT, INTERFACE WITH THE STATE FOR MOTOR VEHICLE RECORDS, ACCESS TO BUREAU REPORTS ON CLAIMS, AND PHYSICAL PROPERTY VERIFICATIONS. THE MAIL SURVEY OF UNDERWRITERS INDICATED THAT THERE ARE A LARGE NUMBER OF FACTORS CONSIDERED IMPORTANT IN THEIR DECISIONS -- LAW VIOLATIONS, ACCIDENTS AND LOSSES, AUTOMOBILE INFORMATION AND PERSONAL CHARACTERISTICS OF DRIVERS. THERE WAS NOTICEABLE VARIATION AMONG RESPONDENTS ON THE USEFULNESS OF INVESTIGATIVE REPORTS; THEY WERE CONSIDERED MOST USEFUL IN DRINK AND DRUG HABITS AND LAW VIOLATIONS, WERE JUDGED OF AVERAGE VALUE FOR ACCIDENTS AND LOSSES SOME PERSONAL FACTORS, AUTO INFORMATION AND YOUTHFUL OPERATORS. RATING FACTORS WERE MORE HIGHLY RANKED THAN NON-RATING FACTORS. IN GENERAL, UNDERWRITERS FROM MUTUAL ORGANIZATIONS RANK ALL FACTORS HIGHEST IN IMPORTANCE AND OBTAIN MORE INFORMATION THAN DO UNDERWRITERS FROM STOCK ORGANIZATIONS. DIRECT WRITERS AND EXCLUSIVE AGENCIES UNDERWRITERS PLACE MORE EMPHASIS THAN INDEPENDENTS ON THE IMPORTANCE OF ACCIDENT AND LOSSES, LAW VIOLATIONS AND AUTOMOBILE INFORMATION, BUT LESS EMPHASIS ON PERSONAL AND YOUTHFUL OPERATOR INFORMATION. SMALL COMPANIES ASSIGN HIGHER FACTOR IMPORTANCE RANKINGS THAN LARGE COMPANIES, WITH LARGE COMPANIES OBTAINING MORE INFORMATION THAN SMALL COMPANIES, EXCEPT IN EMPLOYMENT AND

PERSONAL INFORMATION CATEGORIES. SMALL COMPANIES RANK INVESTIGATIVE REPORTS AS MORE USEFUL THAN DO LARGER ONES. MANY COMPANIES NOW USE DIFFERENT INFORMATION SOURCES, AND EVALUATION METHODS IN PERSONAL LINES UNDERWRITING. CLASSIFICATION, RATING AND SELECTION CRITERIA ON A BROAD IMPERSONAL BASIS MAY BE SUCCESSFUL IN DEALING WITH PRESENT PROBLEMS AND SOME DATA MAY BE USED AS PROXY FOR OTHER IN MAKING CLASS AND RATE DECISIONS. OBTAINING AND PROMOTING THE USE OF STATISTICALLY CREDIBLE INFORMATION IS A PROBLEM. THE INFORMATION REPORTING INDUSTRY HAS BEEN CIRCUMSCRIBED RADICALLY BY LEGISLATION. A NEW APPROACH INVOLVING DIRECT PERSONAL INTERVIEW AND RECORD VERIFICATION FOR PERSONAL FACTORS, PROPERTY INSPECTION AND BUREAU REPORTS, ALL OF WHICH ARE SELF-VERIFYING, WOULD PROVIDE A NEEDED INFORMATION SERVICE.

by JOHN F. ADAMS; LARRY D. GAUNT  
GEORGIA STATE UNIV., CENTER FOR INSURANCE  
RES., ATLANTA, GA.

978; 169P

SUPPORTED BY EQUIFAX SERVICES, INC.

Availability: EQUIFAX SERVICES, INC.,  
PROPERTY/CASUALTY DIV., P.O. BOX 4081, ATLANTA,  
GA. 30302 \$10.00

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#### PREDICTION OF VEHICLE REFERENCE FRONTAL AREA

BEGINNING WITH THE 1979 MODEL YEAR, THE DYNAMOMETER POWER ABSORPTION TO SIMULATE THE VEHICLE ROAD LOAD DURING EXHAUST EMISSION CERTIFICATION TESTING AND FUEL ECONOMY MEASUREMENTS WILL BE PREDICTED BY THE VEHICLE FRONTAL AREA, DEFINED AS THE AREA OF ORTHOGONAL PROJECTION OF THE VEHICLE ONTO A PLANE PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE VEHICLE. THE DETERMINATION OF THIS AREA BY ANALYSIS OF ENGINEERING DRAWINGS, PROJECTION TECHNIQUES FROM THE ACTUAL VEHICLE, OR PLANIMETER MEASUREMENTS FROM PHOTOGRAPHS, IS ACCURATE BUT TIME-CONSUMING. AN EQUATION TO ESTIMATE THE VEHICLE REFERENCE FRONTAL AREA USING THE OVERALL VEHICLE HEIGHT AND WIDTH IS DEVELOPED, USING THE REFERENCE AREA DATA AND THE OVERALL HEIGHT AND WIDTH DATA SUPPLIED BY VEHICLE MANUFACTURERS. THE PRODUCT OF THE OVERALL HEIGHT, WIDTH, AND THE COEFFICIENT, 0.80, YIELDS A GOOD APPROXIMATION OF THE ACTUAL VEHICLE REFERENCE FRONTAL AREA. USING THIS APPROXIMATION, THERE IS 80% CONFIDENCE THAT THE PREDICTED VALUE WILL BE WITHIN PLUS OR MINUS 1.0 SQ FT OF THE ACTUAL REFERENCE FRONTAL AREA. THIS IS APPROXIMATELY 5% OF THE REFERENCE AREA OF A TYPICAL VEHICLE. THIS EQUATION IS RECOMMENDED AS A METHOD FOR EVALUATION OF SUBMITTED REFERENCE AREA DATA OR FOR PREDICTING VEHICLE REFERENCE FRONTAL AREAS WHEN EMPIRICAL DATA ARE NOT AVAILABLE. USE OF THE PREDICTED EQUATION IN THE REGULATORY

PROCESS IS NOT RECOMMENDED BECAUSE OF THE INACCURACIES IN THE CASE OF ATYPICAL VEHICLES. ALSO, IF THE PRODUCT OF THE OVERALL HEIGHT AND WIDTH WERE USED IN THE REGULATORY PROCESS, MANUFACTURERS MIGHT TEND TO PRODUCE THE LARGEST REFERENCE AREA VEHICLE POSSIBLE WITHIN A GIVEN HEIGHT TIMES WIDTH, THUS IMPOSING DESIGN-ORIENTED PRESSURE. IT IS THE VEHICLE REFERENCE AREA THAT IS THE IMPORTANT PARAMETER, NOT THE VEHICLE HEIGHT OR WIDTH.

by HARRIET W. GOODALL; GLENN D. THOMPSON  
ENVIRONMENTAL PROTECTION AGENCY,  
STANDARDS DEVEL. AND SUPPORT BRANCH, ANN  
ARBOR, MICH.

Rept. No. PB-276 541; LDTP-77-7; 1977; 14P 2REFS  
TECHNICAL SUPPORT REPT. FOR REGULATORY ACTION.

Availability: NTIS

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#### A FOUNDATION FOR SYSTEMS ANTHROPOMETRY. PHASE 2. FINAL REPORT

THE EXPERIMENTAL PROCEDURES USED IN AN INVESTIGATION OF THE LANDMARKS, AXES SYSTEMS, AND JOINT PROPERTIES NECESSARY TO DESCRIBE THE HUMAN BODY IN THREE-DIMENSIONAL SPACE ARE DESCRIBED. THREE FRESH CADAVERS WERE USED TO STUDY THE SPATIAL RELATIONSHIP BETWEEN INTERNAL AND EXTERNAL LANDMARKS IN THE LUMBAR/PELVIC/FEMUR REGION OF THE BODY, AS WELL AS THE MOTION CHARACTERISTICS OF THE HIP JOINT IN FLEXION-EXTENSION, ABDUCTION-ADDITION, AND INTERNAL-EXTERNAL ROTATION. THE CIVIL AEROMEDICAL INST.'S STUDY USED 150 MALE AND 150 FEMALE OSTEOLOGICAL SPECIMENS TO INVESTIGATE THE THREE-DIMENSIONAL VARIABILITY OF LANDMARK LOCATIONS IN THE PELVIS. DATA ARE PRESENTED IN TABULAR AND GRAPHICAL FORM. RESULTS TO DATE SHOW THAT BIOLOGICAL VARIABILITY MUST BE CONSIDERED AS A SET OF PROBABILISTIC PHENOMENA IN DETERMINISTIC BIOMECHANICAL MODELS, THAT BODY POSITION AND MOBILITY MUST BE CONSIDERED SIMULTANEOUSLY IN THREE-DIMENSIONAL SPACE, THAT DATA COLLECTION AND ANALYSIS MUST INCORPORATE THE USE OF ANATOMICAL FRAMES OF REFERENCE DEFINED BY FUNCTIONALLY SIGNIFICANT LANDMARKS IN THE SKELETAL SYSTEM, AND THAT BODY POSITION CAN BE DEFINED BY THE LOCATION OF ANATOMICAL FRAMES OF REFERENCE, AND BODY MOBILITY CAN BE DEFINED BY RELATIVE MOTION BETWEEN ADJACENT ANATOMICAL FRAMES OF REFERENCE.

by HERBERT M. REYNOLDS; JAMES R. FREEMAN;  
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REPT. FOR 1 DEC 1976-30 SEP 1977.

Availability: CORPORATE AUTHOR

HS-023 244

**WARNING: IN CARS, PARENTS MAY BE  
HAZARDOUS TO THEIR CHILDREN'S HEALTH.  
THE HAZARDS OF ON-LAP TRAVEL**

IN CAR CRASHES CHILDREN TRAVELING ON LAPS CANNOT BE ADEQUATELY RESTRAINED, AND ARE SUSCEPTIBLE TO SERIOUS INJURIES CAUSED BY BEING CRUSHED BY THE PERSON HOLDING THEM. A 1974 OBSERVATIONAL SURVEY SHOWED THAT OF THOSE LESS THAN ONE YEAR OF AGE, ALMOST HALF TRAVELED ON ADULTS' LAPS, AS DID ONE-FOURTH OF THE ONE-YEAR OLDS; THE FIGURE DECREASED WITH AGE OF THE CHILD. IN MOST CASES BOTH ADULT AND CHILD WERE UNRESTRAINED, IN A FEW CASES BOTH WERE RESTRAINED BY THE SAME SEAT BELT, AND IN SOME CASES THE HOLDER ALONE WAS USING A SEAT BELT. EACH OF THESE PRACTICES IS LIKELY TO RESULT IN THE ADULT INJURING THE CHILD, PARTICULARLY IF BOTH ARE WEARING THE SAME BELT, SINCE THE CHILD IS COMPRESSED BETWEEN THE SEAT BELT AND THE HEAVIER FORWARD-MOVING ADULT. MULTIDISCIPLINARY ACCIDENT INVESTIGATION CASE STUDIES IN WHICH CHILDREN TRAVELING ON LAPS WERE INJURED SHOWED THAT INJURIES DUE TO PROBABLE OR DEFINITE OCCUPANT-TO-OCCUPANT CONTACT OCCURRED IN 42%; THE INJURIES RANGED FROM MINOR SUCH AS LACERATIONS OR ABRASIONS TO FATAL RESULTING FROM MULTIPLE CRUSHING TRAUMA. IN 10 OF THE 14 CRASHES IN WHICH CHILDREN SUSTAINED SEVERE OR FATAL INJURY, THE INJURIES WERE CAUSED OR AGGRAVATED BY CONTACT WITH OTHER VEHICLE OCCUPANTS. ON-LAP TRAVEL IS DIFFICULT TO ELIMINATE THROUGH TECHNIQUES SUCH AS INCREASED INFORMATION, PERSUASION, OR LEGISLATION. MOST COUNTRIES WITH MANDATORY SEATBELT LEGISLATION HAVE EXEMPTED CHILDREN FROM RESTRAINT USE. TENNESSEE'S NEW LAW, EFFECTIVE 1 JAN 1978, WHICH REQUIRES PARENTS OF CHILDREN LESS THAN FOUR TO TRANSPORT THEM IN APPROVED CHILD RESTRAINT SYSTEMS, EXEMPTS CHILDREN FROM RESTRAINT USE IF THEY ARE HELD IN THE ARMS OF OLDER PASSENGERS. THE NEW LAW COULD ACTUALLY INCREASE THE DANGEROUS PRACTICE OF HOLDING YOUNGSTERS AND RESULT IN A NET INCREASE IN INJURIES AND DEATHS AMONG CHILDREN. PRESENT-GENERATION AIR BAGS CAN PROVIDE SUBSTANTIAL CRASH PROTECTION TO UNRESTRAINED CHILDREN AS YOUNG AS THREE YEARS OF AGE, AND IT IS LIKELY THAT THEY WILL PROVIDE SOME PROTECTION TO YOUNGER CHILDREN AND CHILDREN ON LAPS. PEDIATRICIANS AND OTHER PHYSICIANS HAVE AN IMPORTANT ROLE TO PLAY IN DISCOURAGING ON-LAP TRAVEL AND IN ENCOURAGING OTHER TECHNIQUES WHICH REDUCE CRASH INJURIES TO CHILDREN.

by ALLAN F. WILLIAMS  
1978; 15P 18REFS

Availability: INSURANCE INST. FOR HWY. SAFETY,  
WATERGATE 600, SUITE 300, WASHINGTON, D.C. 20037

HS-023 245

**POSITION ON INCLUDING MOPED, MOKICK [MOTOR SCOOTER] AND MOFA [MOTORBIKE] OPERATORS IN THE GROUP OF VEHICLE OPERATORS OBLIGED TO USE PROTECTIVE HELMETS (STELLUNGNAHME ZU EINER AUSDEHNUNG DER SCHUTZHELMTRAGEPFlicht AUF MOPED/MOKICK- UND MOFABENUTZER)**

VARIOUS KINDS OF DATA WERE STUDIED TO DETERMINE WHETHER MOFA [MOTORBIKE], MOPED AND MOKICK [MOTOR SCOOTER] OPERATORS SHOULD BE INCLUDED IN THE GROUP OF MOTORCYCLE OPERATORS OBLIGED TO WEAR PROTECTIVE HELMETS. RESULTS INDICATED THAT ACCIDENT RATES OF MOFA AND MOTORCYCLE USERS HAD INCREASED IN RECENT YEARS IN FATAL, AS WELL AS SERIOUS AND MINOR INJURIES, BECAUSE OF THE SIGNIFICANT INCREASE IN NUMBERS OF THESE VEHICLES. THIS INCREASE IN ACCIDENT RATES WAS NOT EVIDENT FOR BICYCLISTS AND MOPED OPERATORS. INJURIES OUTSIDE BUILT-UP AREAS WERE SERIOUS, THE MAJORITY SUFFERING HEAD INJURIES. FROM A STUDY OF THE DATA AND OF PERTINENT LITERATURE, THE PROTECTIVE EFFECTIVENESS OF HELMETS IN RELATION TO HEAD INJURIES WAS ASSESSED AS POSITIVE. EVEN IF THE LOWEST EFFECTIVENESS VALUES INDICATED IN THE LITERATURE WERE APPLIED, MANDATORY USE OF SAFETY HELMETS BY MOFA, MOPED, AND MOKICK OPERATORS IN 1976 ALONE COULD HAVE REDUCED, IF 100% COMPLIANCE WERE ACHIEVED, THE TOTAL NUMBER OF FATAL INJURIES BY 140 AND THE TOTAL OF SERIOUS AND MINOR INJURIES BY 2200 AND 4400, RESPECTIVELY. TO IMPROVE THE SAFETY OF THIS GROUP OF OPERATORS THE USE OF HELMETS WOULD HAVE TO BE MANDATORY. BASED ON EXPERIENCE WITH AUTOMOBILE SEAT BELTS, IT WAS DETERMINED THAT WITHOUT THE IMPOSITION OF FINES FOR NONCOMPLIANCE, THE PERCENTAGE OF HELMET WEARERS (CURRENTLY 16% OF MOFA AND MOPED OPERATORS AND 10% OF THEIR PASSENGERS) COULD NOT BE RAISED TO AN OPTIMUM 90%. SAFETY HELMETS SHOULD MEET AT LEAST THE PROVISIONS OF DIN 4848 (70) "PROTECTIVE HELMET FOR MOTORCYCLE OPERATORS"; 90% OF HELMETS ON THE MARKET MEET THE DIN SPECIFICATIONS AND STUDIES ARE ALREADY UNDERWAY TO REFINE THESE REQUIREMENTS FURTHER. THE OBLIGATORY USE OF HELMETS SHOULD BE PUT INTO EFFECT AS SOON AS POSSIBLE. COST-EFFECTIVENESS ANALYSIS SHOWED THAT MANDATORY WEARING OF SAFETY HELMETS WAS SENSIBLE FROM THE VIEWPOINT OF THE OVERALL ECONOMY.

by H. LOEFFELHOLZ; E.-A. MARBURGER; M. SCHMID  
BUNDESANSTALT FUR STRASSENWESEN, BEREICH  
UNFALLFORSCHUNG, P.O. BOX 51 05 30, 5000  
COLOGNE 51, GERMANY  
1977; 209P 110REFS  
TEXT ALSO IN GERMAN.  
Availability: REFERENCE COPY ONLY

November 30, 1978

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HS-023 246

### MOTORCYCLE AND MOPED HELMETS (MOTORCYKEL- OCH MOPEDHJALMAR)

PROBLEMS RELATED TO LEGISLATION ON COMPULSORY USE OF SAFETY HELMETS FOR MOTORCYCLE AND MOPED RIDERS, AND THE EFFECTS OF SAFETY HELMETS, WERE STUDIED BY A WORKING GROUP OF THE SCANDINAVIAN ROAD SAFETY COUNCIL. AN EXAMINATION OF TRAFFIC MEDICINE REPORTS SHOWED THAT WEARING OF HELMETS RESULTED IN A SUBSTANTIAL REDUCTION IN THE RISK OF HEAD INJURIES FOR THESE RIDERS, PARTICULARLY FOR INJURIES CAUSED BY FALLING TO THE GROUND, SINCE IMPACT FORCE IS DETERMINED BY THE HEIGHT OF THE FALL AND NOT BY THE FORWARD SPEED OF THE VEHICLE. IT IS POSSIBLE THAT WEARING OF HELMETS WILL DIMINISH THE RISK OF HEAD INJURIES BY MORE THAN ONE QUARTER. SINCE MANY MOTORCYCLE RIDERS ALREADY WEAR HELMETS THE TOTAL GAIN IN ROAD SAFETY FOR THIS GROUP TO BE EXPECTED AS A RESULT OF COMPULSORY HELMET WEARING WOULD NOT BE LARGE, BUT THE LAW WOULD BE VALUABLE FOR INFORMATION AND PROPAGANDA. ONLY A SMALL PERCENT OF MOPED OPERATORS IN FINLAND, NORWAY, AND SWEDEN (MORE IN DENMARK) USE HELMETS FREQUENTLY, AND COMPULSORY WEARING WOULD RESULT IN SUBSTANTIAL ROAD SAFETY FOR THIS GROUP. EXPERIENCE HAS SHOWN THAT INFORMATION AND PROPAGANDA ALONE CANNOT INCREASE HELMET USE AMONG MOPED OPERATORS TO ANY EXTENT. A TRANSITIONAL PERIOD OF ONE YEAR IS PROPOSED BETWEEN ENACTMENT OF A COMPULSORY LAW AND ENFORCEMENT. HELMET WEARING SHOULD BE COMPULSORY IN URBAN AS WELL AS RURAL AREAS SINCE THE PROTECTIVE CAPACITY OF THE HELMET APPLIES IN PARTICULAR TO INJURIES CAUSED BY FALLING. PRESENT HELMETS ARE NOT INTENDED FOR USE BY CHILDREN, AND IT MAY BE DIFFICULT TO PROCURE HELMETS FOR CHILDREN BECAUSE OF SIZE AND WEIGHT DIFFERENCES. ACCORDINGLY, IT IS PROPOSED THAT THE LAW, AS FAR AS MOTORCYCLE PASSENGERS ARE CONCERNED, SHOULD APPLY ONLY TO PERSONS 15 YEARS OF AGE AND OLDER, AND THAT, FOR MOPED RIDERS, THE LAW SHOULD APPLY ONLY TO OPERATORS. FUTURE DEVELOPMENT OF HELMETS SUITABLE FOR CHILDREN SHOULD BE ENCOURAGED. SOME PROTECTION FOR CHILDREN MAY BE OBTAINED BY USE OF AN ICE HOCKEY HELMET, FOR EXAMPLE. ULTIMATELY ONLY APPROVED HELMETS SHOULD BE WORN, AND TESTING AND MARKETING OF THESE HELMETS SHOULD BE COORDINATED IN THE SCANDINAVIAN COUNTRIES. EXEMPTIONS FROM THE LAW BECAUSE OF MEDICAL REASONS SHOULD BE ALLOWED ONLY RARELY. EACH COUNTRY SHOULD BE ALLOWED TO CHOOSE ITS OWN SANCTIONS; COMPENSATION FOR DAMAGES SHOULD NOT BE REDUCED ON GROUNDS OF HELMET NON-USE. APPENDED ARE SECTIONS ON TECHNICAL AND MEDICAL VIEWPOINTS OF HELMET QUALITY, A NORWEGIAN STUDY OF THE PROTECTIVE EFFECT OF HELMETS, AND A REPORT

DEVELOPING A METHOD OF CALCULATION FOR EVALUATING PROTECTIVE EFFECT.

NORDISK TRAFIKSIKKERHEDS RAD, STOCKHOLM,  
SWEDEN  
Rept. No. NTR-8; 1974; 163P 79REFS  
TEXT ALSO IN SWEDISH. INCLUDES FINNISH  
SUMMARY.  
Availability: REFERENCE COPY ONLY

HS-023 247

### RIGHT-TURN-ON-RED IN INDIANA

IN INDIANA RIGHT-TURN-ON-RED (RTOR) WAS MANDATED BY THE LEGISLATURE EFFECTIVE 1 JUL 1974. DATA FROM TWO RESEARCH PROJECTS REVEALED THAT THERE WAS NO INCREASE IN THE TOTAL NUMBER OF ACCIDENTS AS A RESULT OF RTOR; NO PEDESTRIANS WERE PLACED IN A MORE HAZARDOUS SITUATION. DELAY REDUCTION TO RIGHT-TURNING VEHICLES OCCURRED, VARYING FROM NO REDUCTION TO AS MUCH AS 15 SEC PER RIGHT-TURNING VEHICLE. VERY LITTLE DRIVER IRRITATION WAS FOUND. THE RTOR MANEUVER WAS MADE BY AN AVERAGE OF ONLY 19.5% OF THE TOTAL RIGHT-TURNING VEHICLES (3.7% OF THE TOTAL APPROACH VOLUME). CITY SIZE, NUMBER OF APPROACH LANES AND AN EXCLUSIVE RIGHT TURN LANE HAD SIGNIFICANT EFFECTS ON RTOR (21.3% OF TOTAL RIGHT-TURNING VEHICLES MADE RTOR IN LARGE CITIES, 15.6% IN SMALL; THE PERCENT OF DRIVERS REFUSING TO TURN ON RED WAS HIGHER ON ONE-LANE APPROACHES THAN ON MULTILANE; IN EXCLUSIVE RIGHT-TURN LANES 26.3% OF THE TOTAL WERE RTOR, 19.3% WHEN THERE WAS NOT A RIGHT TURN LANE). THE PERCENT OF RTOR VEHICLES INCREASED SIGNIFICANTLY WITH A DECREASE OF APPROACH TRAFFIC AND CROSS TRAFFIC VOLUME. THE LEFT-TURN-ON-RED (LTOR) MANEUVER WAS USED BY ONLY 1.3% OF THE TOTAL LEFT-TURNING VEHICLES (0.26% OF TOTAL APPROACH VOLUME). VEHICLES MAKING RTOR WHERE PROHIBITED WERE 1.4% OF THE TOTAL RIGHT-TURNING VEHICLES. MOST TRAFFIC OFFICIALS ARE IN FAVOR OF ALLOWING RTOR. PROBLEMS NOTED WERE THAT SOME RTOR VEHICLES DID NOT COME TO A FULL STOP (THIS WAS NOT A MAJOR PROBLEM), THERE IS NO UNIFORM LAW ON THE MANEUVER IN ALL STATES, AND SOME DRIVERS REFUSE TO TURN ALTHOUGH THEY HAVE THE CHANCE. THE STUDIES AND EXPERIENCE PROVIDED THE INDIANA STATE HWY. COMMISSION WITH SUGGESTED WARRANTS: TURNS ON RED SHOULD BE PROHIBITED FOR REASONS OF SIGHT DISTANCE, WHEN THE INTERSECTION HAS MORE THAN FOUR APPROACHES, AND AT CERTAIN INTERSECTIONS WHERE OTHER DIRECTIONAL ARROWS AND/OR LANE NARROWING CAUSE CONFLICTS. RTOR MAY BE PROHIBITED BECAUSE OF LITTLE BENEFIT FROM THE MANEUVER WHERE THE RED PHASE IS VERY SHORT, CROSS STREET TRAFFIC OR PEDESTRIAN USE IS HEAVY, OR WHERE LITTLE DEMAND EXISTS. IN ADDITION, TURNS MAY BE PROHIBITED BECAUSE OF ADVERSE PUBLIC REACTION (NEAR SCHOOLS OR

HS-023 248

HSL 78-1

WHERE MODERATE TO HEAVY PEDESTRIAN VOLUME OCCURS).

by MICHAEL MAMLOUK; RONALD L. MAY; HAROLD L. MICHAEL  
PURDUE UNIV., JOINT HWY. RES. PROJ.  
1975?; 21P 18REFS

Availability: REFERENCE COPY ONLY

HS-023 248

### GAS AND PARTICLE EMISSIONS FROM AUTOMOBILE TIRES IN LABORATORY AND FIELD STUDIES

THE WEAR PRODUCTS FROM AUTOMOBILE TIRES ARE POTENTIAL POLLUTANTS, THE AVERAGE RATE PER TIRE BEING 90 MG/KM. TO DETERMINE THE CONTRIBUTION WHICH AUTOMOBILE TIRES MAKE TO AIR POLLUTION, THE EMISSIONS FROM TIRES RUN IN AN ENCLOSED INDOOR TEST FACILITY WERE COLLECTED AND THE GASEOUS HYDROCARBON AND SULFUR COMPOUNDS EMITTED WERE IDENTIFIED AND MEASURED. THE EMISSION OF MONOMERS AND DIMERS OF STYRENE-BUTADIENE RUBBER (SBR) INDICATED THAT LOCAL AREAS OF THE CONTACT PATCH EXPERIENCE THE THERMO-MECHANICAL EQUIVALENT OF HIGH TEMPERATURE. SEVERE POLYMER DEGRADATION AND VOLATILIZATION OF EXTENDER OIL RESULT IN AEROSOL EMISSIONS DEFICIENT IN SBR POLYMER. HOWEVER, DISTINCT AREAS OF ABRASION GIVE RISE TO MOST OF THE TIRE WEAR AS PARTICLES WHICH SETTLE CLOSE TO THE ROADWAY. MEASUREMENTS OF SBR IN AIRBORNE PARTICULATES NEXT TO THE SAN GABRIEL RIVER FREEWAY IN CALIFORNIA DEMONSTRATED THAT MOST TIRE WEAR PARTICLES ARE NOT SUSPENDABLE. TREAD RUBBER CONCENTRATIONS WERE EQUIVALENT TO LESS THAN 5% OF THE TOTAL WEAR, AND TREAD RUBBER ACCUMULATION IN THE SOIL ADJACENT TO THE FREEWAY WAS EQUIVALENT TO A DEPTH OF LESS THAN 0.5 MM. THIS TIRE DEBRIS HAD SETTLED WITHIN 5.0 M OF THE PAVEMENT EDGE. ANY MECHANISM WHICH REMOVES THE RUBBER PARTICLES OR REDUCES THE AMOUNT OF SBR IN THE RUBBER PARTICLES MINIMIZES APPARENT ACCUMULATION. FIELD MEASUREMENTS CONFIRMED THE INDOOR EMISSION PATTERN, VERIFYING THAT TIRE WEAR PRODUCTS ARE NOT A SIGNIFICANT AIR POLLUTION PROBLEM. GASEOUS EMISSIONS OF 2.4 MG/KM/CAR AND AIRBORNE PARTICULATE EMISSIONS OF 2-5 MG/KM/CAR ARE NEGLIGIBLE COMPARED WITH OTHER AIR POLLUTION SOURCES. ALTHOUGH THE HYDROCARBONS CAN PARTICIPATE IN SMOG REACTIONS, THEIR MASS EMISSION RATE IS LESS THAN 0.1% OF THE CURRENT EXHAUST HYDROCARBON EMISSION RATE.

by S. H. CADLE; R. L. WILLIAMS  
Publ: JOURNAL OF THE AIR POLLUTION CONTROL ASSOCIATION V28 N5 P502-7 (MAY 1978)  
1978; 17REFS

Availability: SEE PUBLICATION

HS-023 249

### FOR BETTER STEERING AND RIDE CONTROL...TAKE A CLOSE LOOK AT THE LINKAGE

THE LINKAGE BETWEEN THE MOTOR VEHICLE'S PITMAN ARM AND THE STEERING ARM, INCLUDING THESE TWO COMPONENTS, IS DESCRIBED IN DETAIL. THE MOST COMMONLY USED LAYOUT OF STEERING LINKAGE HAS BEEN THE PARALLELOGRAM-TYPE FEATURING A PITMAN ARM, AN IDLER ARM AND BRACKET, TWO PIVOT ASSEMBLIES AND A ONE-PIECE FORGED STEEL DRAG LINK. THE STEERING LINKAGE HOLDS THE TWO FRONT WHEELS PARALLEL TO EACH OTHER WHILE THE CAR IS GOING STRAIGHT AHEAD, AND IT PROVIDES A MEANS FOR THE DRIVER TO TURN THE WHEELS AN EXACT AMOUNT IN TURNING. RATHER THAN SPINDLING THE FRONT WHEELS TO A SOLID AXLE BOLTED TO THE VEHICLE AT THE AXLE'S CENTER-POINT, ACKERMAN DESIGNED A SYSTEM OF STEERING LINKAGE TO HOLD THE AXLE FIRM AT ALL TIMES, WHILE THE SPINDLES TO WHICH THE WHEELS ARE MOUNTED WERE PIVOT-PINNED TO THE ENDS OF THE AXLE SO THAT EACH FRONT WHEEL WAS FREE TO TURN WITHOUT BOthering THE AXLE. TO COMPENSATE FOR THE CONDITION OF THE INSIDE WHEEL TURNING THROUGH A DIFFERENT ARC AND TRAVELLING A SHORTER DISTANCE THAN THE OUTSIDE WHEEL, STEERING ARMS ARE ATTACHED BETWEEN THE LINKAGE AND THE SPINDLE AT EACH WHEEL. THESE ARMS ANGLE REARWARD AND INWARD SO THAT WHEN THE WHEELS ARE TURNED THE STEERING ARM AND LINKAGE ON THE INSIDE WHEEL TENDS TO "STRAIGHTEN OUT" WHILE THE OUTSIDE WHEEL TENDS TO "GET A SHARPER ANGLE," A DIFFERENCE CALLED TOE-OUT ON TURNS, A MEASUREMENT GIVEN IN DEGREES. WHEN A VEHICLE'S FRONT SPRINGS SAG APPRECIABLY THE STEERING LINKAGE PARALLELISM IS UPSET PROPORTIONATELY, CAUSING TIRE WEAR AND DOWNGRADING VEHICLE HANDLING. NEW SPRINGS ARE CALLED FOR, ALTHOUGH SOMETIMES AUXILIARY SPRING BOOSTERS WILL OVERCOME THE SAG PROBLEM. IF STANDING HEIGHT IS SATISFACTORY BUT STEERING LINKAGE IS NOT PARALLEL TO A FLAT SURFACE WHEN THE VEHICLE IS ON A FLAT SURFACE THERE ARE SEVERAL ADJUSTMENTS WHICH CAN BE MADE, EITHER TO THE IDLER ARM, PITMAN ARM, STEERING GEAR OR TIE ROD, AND THESE ADJUSTMENTS ARE DESCRIBED AND ILLUSTRATED. PERIODIC SERVICE FOR STEERING LINKAGE INVOLVES VISUAL INSPECTION AND LUBRICATION OF THE PIVOT POINTS.

by HERB CARRIER  
Publ: TIRE REVIEW V78 N5 P52-4 (MAY 1978)  
1978

Availability: SEE PUBLICATION

HS-023 250

### INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,

**MELBOURNE, AUSTRALIA, JANUARY 31-  
FEBRUARY 4, 1977**

THE BENEFICIAL RESULTS OF MANDATORY SEATBELT LEGISLATION IN MANY COUNTRIES AND HOW THE EFFECTIVENESS OF RESTRAINT SYSTEMS, ESPECIALLY THOSE FOR CHILDREN, MAY BE IMPROVED WERE ADDRESSED. THE CONFERENCE PASSED EIGHT RESOLUTIONS. FIRST, IT IS RECOMMENDED THAT MANDATORY SEATBELT USE LAWS BE INTRODUCED IN ALL COUNTRIES. SECOND, MANDATORY SEATBELT USE LAWS SHOULD COVER ALL OCCUPANTS OF PASSENGER CARS AND DERIVATIVES, IRRESPECTIVE OF SEATING POSITION AND AGE. THIRD, MANDATORY SEATBELT USE LAWS SHOULD COVER NOT ONLY THE DRIVERS OF AND PASSENGERS IN PASSENGER CARS, BUT ALSO THE DRIVERS OF AND PASSENGERS IN TAXIS AND TRUCKS, AND THE DRIVERS OF BUSES. FOURTH, WITH RESPECT TO THE PROTECTION OF CHILD PASSENGERS, THE FOLLOWING ARE RECOMMENDED: CONTINUE RESEARCH CONCERNING CHILD RESTRAINT SYSTEMS AND MAKE AVAILABLE APPROPRIATE FUNDS BY GOVERNMENT AND OTHER AUTHORITIES, USE TESTED DEVICES CURRENTLY APPROVED BY COMPETENT AUTHORITIES FOR PROTECTION OF CHILDREN AND MAKE THESE DEVICES MANDATORY AS THEY BECOME AVAILABLE, DO NOT ALLOW CHILDREN TO RIDE IN THE FRONT COMPARTMENTS OF PASSENGER CARS UNLESS SUITABLE RESTRAINTS ARE AVAILABLE AND USED, AND REQUIRE CHILDREN WHO ARE ABLE TO SIT UP UNSUPPORTED TO USE ADULT SEAT BELTS IF NO MORE SUITABLE DEVICES ARE AVAILABLE. FIFTH, ALL THOSE WORKING WITH AND ANALYZING INJURY DATA SHOULD USE THE ABBREVIATED INJURY SCALE (AIS), AND THE STANDARDIZATION OF THE FORMAT FOR OTHER DATA RELATING TO ACCIDENT AND TRAFFIC MEDICINE RESEARCH SHOULD BE PURSUED. SIXTH, STUDIES SHOULD BE CONTINUED INTO THE EFFECTIVENESS, COST, AND ACCEPTABILITY OF PASSIVE RESTRAINT SYSTEMS, WITH A VIEW TO THE ULTIMATE PROTECTION OF ALL VEHICLE OCCUPANTS. SEVENTH, IMPROVEMENT IN THE OCCUPANT PROTECTION AND GENERAL COMFORT REQUIREMENTS OF VEHICLE SAFETY STANDARDS AND SPECIFICATION OF CRITERIA FOR REPLACEMENT OF SEAT BELTS WHICH HAVE DETERIORATED OR HAVE BEEN INVOLVED IN A CRASH SHOULD BE KEPT UNDER REVIEW. AND, EIGHTH, INCREASED ATTENTION SHOULD BE GIVEN TO ROAD ENGINEERING AND TRAFFIC MANAGEMENT TECHNIQUES TO MINIMIZE OPERATING SPEEDS IN CONFLICT SITUATIONS.

INTERNATIONAL ASSOC. FOR ACCIDENT AND TRAFFIC MEDICINE

1977; 574P REFS

INCLUDES HS-023 251--HS-023 293.

Availability: REFERENCE COPY ONLY

HS-023 251

**SAFETY BELT USE LAWS - THE WORLD FOLLOWS  
AUSTRALIA'S LEADERSHIP**

THE WORLDWIDE EFFECT OF AUSTRALIA'S PIONEERING LEADERSHIP WITH THE ENACTMENT OF MANDATORY SEATBELT USAGE LEGISLATION IN VICTORIA IN LATE 1970 AND IN ALL OF THE AUSTRALIAN STATES SHORTLY THEREAFTER IS RECOGNIZED. TWENTY OTHER COUNTRIES AND GOVERNMENTS HAVE FOLLOWED AUSTRALIA'S EXAMPLE IN SEATBELT USE LAWS, WHILE THE NUMBER WILL BE INCREASING EVEN MORE IN 1977. IN EVERY COUNTRY THE SEATBELT PROGRAM HAS BEEN A SUCCESS, A SUCCESS IN THAT THERE HAS BEEN AN IMMEDIATE INCREASE IN THE SEATBELT USAGE RATES, AT LEAST A DOUBLING, SOMETIMES AS MUCH AS A FIVEFOLD INCREASE, IN THAT THERE HAS BEEN A DRAMATIC DROP IN OCCUPANT DEATHS, USUALLY 15% TO 20%, AND IN THAT THERE HAS BEEN A SUBSTANTIAL REDUCTION IN SERIOUS INJURIES, USUALLY IN THE ORDER OF 20% TO 30%. VARIOUS ASPECTS OF THE MANDATORY SEATBELT USAGE LEGISLATION IN AUSTRALIA, FRANCE, GERMANY, NORWAY, SWEDEN, AND CANADA ARE CITED. ON THE NEGATIVE SIDE, IT IS POINTED OUT THAT THE U.S. HAS YET TO ENACT SUCH LEGISLATION. THIRTY STATE LEGISLATURES HAVE CONSIDERED AND INTRODUCED SUCH LAWS, AND IN FIVE STATES THE LAW HAS PASSED IN ONE OF THE TWO HOUSES, BUT NO FULL LEGISLATURE HAS VOTED THE MEASURE FAVORABLY. SOME OF THE REASONS FOR THIS FAILURE TO PASS SEATBELT USAGE LEGISLATION INCLUDE THE GREAT EMPHASIS PLACED ON PASSIVE RESTRAINT SYSTEMS, SUCH AS THE AIR BAG, BY THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) DURING THE PAST EIGHT YEARS, THE ILL-STARRED SEATBELT INTERLOCK THAT WAS MANDATED BY NHTSA IN 1973 AND WAS RESCINDED BY ACT OF CONGRESS IN 1974 BECAUSE OF NEGATIVE PUBLIC OPINION, AND THE COMPLAINT THAT THERE IS A LACK OF ADEQUATE DATA DOCUMENTING THE BENEFITS OF MANDATORY USE OF SEAT BELTS. HOWEVER, THE OUTLOOK FOR SEATBELT USE LAWS IN THE U.S. IS IMPROVING. RECENTLY THE PRESIDENTS OF FORD, GENERAL MOTORS, CHRYSLER, AND AMC HAVE TAKEN POSITIONS PLACING THEIR CORPORATIONS IN FAVOR OF SUCH LEGISLATION, AS WELL AS THE PRESIDENT OF THE UNITED AUTO WORKERS, MANY WOMEN'S GROUPS, AND IMPORTANT NEWSPAPERS. BUT PERHAPS THE MOST HEARTENING SUPPORT IS THE EVIDENCE THAT THE FEDERAL GOVERNMENT IS SOFTENING ITS ATTITUDE AND SKEPTICISM OF BELT LAWS.

by CHARLES H. PULLEY

AMERICAN SAFETY BELT COUNCIL

Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P11-6

1977

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HS-023 252

**ADDRESS BY IAATM [INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE] EXECUTIVE DIRECTOR RUNE ANDREASSON TO THE INAUGURAL SESSION OF THE 6TH INTERNATIONAL CONFERENCE OF THE IAATM, IN MELBOURNE, AUSTRALIA ON 1 FEBRUARY 1977**

A BRIEF OVERVIEW OF THE SEATBELT USAGE SITUATION WORLDWIDE IS PRESENTED. IN THE INDUSTRIALIZED AND MOTORIZED PART OF THE WORLD, THE SAFETY BELT HAS BEEN ACCEPTED AS AN EFFICIENT INJURY-REDUCING SAFEGUARD IN CARS. IN SEVERAL DEVELOPING COUNTRIES, LEGISLATION REQUIRING THE USE OF SEAT BELTS IS BEING CONSIDERED. BUT BEYOND THAT, PEOPLE SEEM FAIRLY UNINTERESTED. AUSTRALIA WAS THE FIRST COUNTRY IN THE WORLD TO PERCEIVE THE NECESSITY OF NOT ONLY HAVING THE SAFETY BELT INSTALLED IN CARS BUT OF ITS BEING USED AS WELL. IN NO COUNTRY HAS SAFETYBELT USE REACHED DESIRED LEVELS WITHOUT THE ENACTMENT OF LEGISLATION MAKING SUCH USE MANDATORY. THROUGHOUT THE WORLD, TAXI DRIVERS ARE ROUTINELY EXEMPTED FROM THE REQUIREMENT TO WEAR SEAT BELTS; THOSE COUNTRIES WHICH HAVE LEGISLATED MANDATORY USE OF SEAT BELTS FOR TAXI DRIVERS INCLUDE AUSTRALIA, BELGIUM, CZECHOSLOVAKIA, ISRAEL, AND THE USSR. FOR TRUCK DRIVERS, THE SEATBELT SITUATION IS EVEN WORSE; THE MANDATORY SEATBELT USE LAW APPLIES TO TRUCK DRIVERS ONLY IN THE AUSTRALIAN STATES OF NORTHERN TERRITORY, QUEENSLAND, SOUTH AUSTRALIA, AND TASMANIA, AND IN THE SCANDINAVIAN COUNTRIES, PROVIDED THAT THE TRUCK IS EQUIPPED WITH SEAT BELTS. IN COUNTRIES WITH SEATBELT USE LEGISLATION, THE LAWS ONLY APPLY TO DRIVERS AND FRONT-SEAT PASSENGERS, EXCEPT FOR AUSTRALIA, ONTARIO (CANADA), AND THE USSR. IN THE SCANDINAVIAN COUNTRIES AND IN SWITZERLAND, PERSONS ARE EXEMPTED FROM THE SEATBELT REQUIREMENT IF THEY ARE UNDER A CERTAIN HEIGHT AND/OR UNDER A CERTAIN AGE. PROGRESS IN THE SEATBELT FIELD HAS BEEN RAPID, BUT THE PROGRESS THAT CAN STILL BE EXPECTED MUST NOT PREVENT THE USE OF SUCH INJURY-PREVENTION EQUIPMENT.

by RUNE ANDREASSON  
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1977; 1REF  
Availability: IN HS-023 250

HS-023 253

**COMPULSORY SEAT BELT LEGISLATION IN NEW ZEALAND**

THE EFFECTIVENESS OF THE FIRST TWO YEARS OF 1972 LEGISLATION REQUIRING THE USE OF SEAT

BELTS IN NEW ZEALAND IS EVALUATED. SEATBELT LEGISLATION HAS SO FAR BEEN INTRODUCED IN THREE PHASES AS FOLLOWS: JAN 1965, SEAT BELT REQUIRED TO BE FITTED TO ALL NEW LIGHTWEIGHT VEHICLES; JUN 1972, SEAT BELT REQUIRED TO BE WORN IN LIGHTWEIGHT VEHICLE REGISTERED AFTER 1 JAN 1965 AND COMBINATION LAP AND DIAGONAL OR FULL HARNESS FITTED TO VEHICLES FIRST REGISTERED AFTER 1 JUL 1972; AN JAN 1975, SEAT BELTS REQUIRED TO BE FITTED AND WORN IN LIGHTWEIGHT VEHICLES REGISTERED AFTER 1 JAN 1955. FOLLOWING THE COMPULSORY USE LAW, IT WAS FOUND THAT THE PERCENTAGE OF THOSE REQUIRED TO WEAR BELTS (DRIVER AND FRONT-SEAT PASSENGERS 15 YEARS OF AGE OR OLDER) WHO ACTUALLY DID INCREASED FROM 39.5% TO 86.6%. FOR MOST OF THE TWO-YEAR PERIOD THERE WAS VERY HIGH TRAFFIC GROWTH AND ECONOMIC ACTIVITY. IN SUCH PERIODS IT IS NOT UNCOMMON TO EXPERIENCE A SUBSTANTIAL INCREASE IN TRAFFIC ACCIDENTS. HOWEVER, DURING THIS PERIOD DRIVER AND FRONT-SEAT PASSENGER FATALITIES INCREASED ONLY 3%, COMPARED TO 40% FOR OTHER ROAD USERS. AN ANALYSIS OF DRIVERS OF LIGHTWEIGHT VEHICLES FOR YEAR BEFORE AND ONE YEAR AFTER THE LEGISLATION SHOWED THAT FOR POST-1965 VEHICLES (THOSE AFFECTED BY THE LEGISLATION), REGISTRATIONS INCREASED 20% BUT FATAL AND SERIOUS TRAFFIC INJURIES DECREASED 10% AND INJURIES PER VEHICLE DECREASED 18%. FOR PRE-1965 VEHICLES, REGISTRATIONS DECREASED 5%, FATAL AND SERIOUS INJURIES DECREASED 2%, AND INJURIES PER VEHICLE INCREASED marginally. DURING THE FIRST TWO MONTHS OF THE LAW, THERE WERE THREE TIMES THE PROPORTION OF SERIOUS AND FATAL INJURIES WHEN BELTS WERE NOT USED THAN WHEN THEY WERE USED. THERE WERE ALSO A HIGHER USAGE RATE AMONG ADULTS AND A HIGHER PROPORTION OF HEAD INJURIES, CASES OF SHOCK, AND EJECTION RATES WHEN BELTS WERE NOT USED. A NUMBER OF MINOR INJURIES WERE CAUSED BY THE BELTS, PROBABLY BECAUSE OF INCORRECT USAGE.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P21-39  
1977; 4REFS

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HS-023 254

**EFFECTS OF MANDATORY SEAT BELT LEGISLATION IN FRANCE**

FRANCE'S MANDATORY SEATBELT USAGE LEGISLATION, ENACTED ON 1 JUL 1973, REQUIRES THE USE OF SEAT BELTS BY DRIVERS AND FRONT-SEAT PASSENGERS OF PRIVATE VEHICLES, OUTSIDE THE CITY. A STUDY OF 72,390 VEHICLES DURING 1974 AND 1975 REVEALED THAT THE PERCENTAGE OF SEATBELT USERS ROSE FROM 53.6% IN 1974 TO 75.0% IN 1975. FROM 1972 TO 1975, WHILE TRAFFIC INCREASED ON THE WHOLE BY AT LEAST 10%, THE NUMBER OF

MOTORISTS KILLED DECREASED BY 21%. FURTHERMORE, AN ANALYSIS OF 111,763 CASES INVOLVING RIVERS OR FRONT-SEAT PASSENGERS WHO WERE ACCIDENT VICTIMS IN 1975 REVEALED THAT AMONG THOSE NOT WEARING A SEAT BELT (24.6% OF THE TOTAL CASES), 1456 WERE KILLED AND AMONG THE SEATBELT USERS, ONLY 1666 WERE KILLED (1.96% OF THE CASES). THIS SAME INVESTIGATION INDICATED THAT MORE THAN 4000 LIVES MIGHT VERY LIKELY HAVE BEEN SAVED IF THE SEAT BELT HAD BEEN WORN. THUS THE SEAT BELT SEEMS TO BE INEXPENSABLE IN REDUCING THE NUMBER OF VICTIMS OF CAR ACCIDENTS; HOWEVER, IT IS INSUFFICIENT ALONE. ON THE HIGHWAYS IN FRANCE, THE DEATH RATE, WHICH WAS NOT Affected BY THE OMPULSORY SEATBELT USAGE LEGISLATION, INCREASED IN A FEW MONTHS BY 57% WHEN A COMPLEMENTARY MEASURE LIMITING SPEED WAS INTRODUCED. UNFORTUNATELY, HOWEVER, ONE PERSON OUT OF FIVE STILL DOES NOT WEAR A SEAT BELT OUTSIDE THE CITY AND MOST PEOPLE DO NOT USE THEM IN URBAN TRAFFIC.

by J. P. CHODKIEWICZ; B. DUBARRY  
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OSPITALIER SAINTE-ANNE, 1 RUE CABANIS, 75674  
PARIS, CEDEX 14, FRANCE  
Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
THE INTERNATIONAL ASSOCIATION FOR ACCIDENT  
AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P40-4

Availability: IN HS-023 250

S-023 255

### EFFECTS OF SWEDEN'S SEAT-BELT LAW

THE EFFECT OF SWEDEN'S MANDATORY SEATBELT USAGE LEGISLATION ON TRAFFIC INJURIES WAS INVESTIGATED BY STUDYING PERSONS INJURED IN TRAFFIC WHO SOUGHT TREATMENT AT HOSPITAL EMERGENCY ROOMS OR WHO WERE ADMITTED TO HOSPITALS AFTER TRAFFIC ACCIDENTS. THE LAW REQUIRING THE USE OF SEAT BELTS BY DRIVERS AND FRONT-SEAT PASSENGERS OF CARS CAME INTO FORCE ON 1 JAN 1975. AT THE 16 HOSPITALS COVERED BY THIS STUDY, THE NUMBER OF TRAFFIC ACCIDENT VICTIMS SEEKING TREATMENT AT AN EMERGENCY-RECEIVING SECTION DURING THE PERIOD OCT-DEC 1975 DROPPED BY 19% COMPARED TO THE SAME MONTHS IN 1974. THE NUMBER OF PERSONS ADMITTED TO ONE OF THE 16 HOSPITALS FOR TREATMENT OF TRAFFIC INJURIES DROPPED BY 1% FOR THE SAME COMPARISON PERIODS. FURTHERMORE IT WAS FOUND THAT THE TRAFFIC INJURIES TO SEATBELT USERS WERE ALWAYS LESS SEVERE THAN IF NO BELT HAD BEEN USED. IT WAS FOUND THAT THE BELT WAS USED CORRECTLY AS A RULE, BUT MOTORISTS NEED TO RECEIVE SOME INFORMATION ADVISING THEM OF THE IMPORTANCE OF NOT TWISTING THE SEAT BELTS.

by RUNE ANDREASSON; KIELL ROOS  
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PPSALA, INST. FOR SOCIAL MEDICINE, SWEDEN  
Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
THE INTERNATIONAL ASSOCIATION FOR ACCIDENT

AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P45-55  
1977  
SPONSORED BY THE SWEDISH ROAD SAFETY  
OFFICE.  
Availability: IN HS-023 250

HS-023 256

### EXPERIENCES WITH THE NEW SEAT-BELT LAW ON FATAL LESIONS OF CAR OCCUPANTS IN DENMARK. A PRELIMINARY REPORT, BASED ON FATALITIES JAN. THROUGH JUNE 1976

FATAL TRAFFIC ACCIDENTS WHICH OCCURRED IN DENMARK DURING THE PERIOD JAN THROUGH JUN 1976 WERE STUDIED WITH RESPECT TO THE USAGE OF SEAT BELTS BY CAR OCCUPANTS AND THE SEVERITY OF INJURIES SUSTAINED BY THE VICTIMS. THIS TIME PERIOD REPRESENTS THE FIRST SIX MONTHS THAT THE DANISH MANDATORY SEATBELT USAGE LEGISLATION HAD BEEN IN EFFECT. THE USE OF BELTS AMONG FRONT-SEAT OCCUPANTS INCREASED FROM LESS THAN 25% TO 51%, 87%, AND 82% USAGE, RESPECTIVELY, A FEW MONTHS AFTER THE INTRODUCTION OF THE LAW. HOSPITALS REPORTED A DECREASE OF 32% IN INJURIES AMONG FRONT-SEAT OCCUPANTS DURING THE FIRST SIX MONTHS OF THE LAW COMPARED TO WHAT NORMALLY MIGHT HAVE BEEN EXPECTED. HOWEVER, THE ABSOLUTE NUMBER OF FATALITIES AMONG CAR OCCUPANTS DID NOT DECREASE; IN THIS REGARD, AN INCREASED AMOUNT OF TRAFFIC DURING THIS PERIOD MUST BE TAKEN INTO CONSIDERATION. THE BELT USAGE AMONG THE FATALITIES WAS 29%, CORRESPONDING TO AN OVERALL USE OF THE BELT BY CAR OCCUPANTS INVOLVED IN FATAL ACCIDENTS OF 64%. THE RELATIVE PROTECTION AFFORDED PASSENGERS WEARING BELTS WAS THE GREATEST IN ACCIDENTS IN WHICH THE CAR OVERTURNED, FOLLOWED BY FRONTAL (INCLUDING OBLIQUE-FRONTAL) IMPACTS, CONTRALATERAL SIDE IMPACTS, AND HOMOLATERAL SIDE IMPACTS. IT WAS ALSO FOUND THAT DRIVERS AND PASSENGERS UNDER THE INFLUENCE OF ALCOHOL USED THE BELT MUCH LESS THAN OTHERS, AND THIS WAS THE MAIN REASON THAT THE TOTAL NUMBER OF FATALITIES DID NOT DECREASE.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
THE INTERNATIONAL ASSOCIATION FOR ACCIDENT  
AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P56-69

1977  
Availability: IN HS-023 250

HS-023 257

### THE DANISH SEAT BELT ACT [DENMARK, LEGISLATION]

THE DANISH MANDATORY SEATBELT USE LAW, EFFECTIVE 1 JAN 1976, IS BRIEFLY DESCRIBED. THE LAW APPLIES TO ANY FRONT-SEAT OCCUPANT IN A

CAR FITTED WITH SEAT BELTS. SINCE THE FIRST OF APR 1976, PERSONS FOUND NOT USING THE SEAT BELT HAVE BEEN PENALIZED BY A MODEST FINE. THE STATUTE CONTAINS EXEMPTIONS FOR PERSONS UNDER 15 YEARS OF AGE OR BELOW THE HEIGHT OF 150 CM, AS WELL AS PERSONS HAVING A CERTIFIED MEDICAL PROBLEM WHICH PRECLUDES USE OF A SEAT BELT. SEAT BELTS DO NOT HAVE TO BE WORN WHEN THE CAR IS BEING DRIVEN IN REVERSE OR WHEN IT IS BEING DRIVEN IN A PARKING SPACE, FILLING STATION, OR COMPARABLE AREA. EXCEPTIONS TO THE REQUIREMENT INCLUDE TAXI DRIVERS, DRIVERS OF POSTAL VEHICLES AND OTHER COMMERCIAL VEHICLES BEING DRIVEN AT SLOW SPEED AND WITH A DISTANCE OF 500 M OR LESS BETWEEN STOPS. THE STATUTE CONTAINS A CLAUSE THAT STATES THE LAW WILL BE REVIEWED FOR POSSIBLE REVISION IN THE 1977-1978 PARLIAMENTARY SESSION, AND FOR THIS REASON THE DANISH COUNCIL FOR ROAD SAFETY RES. IS PRESENTLY CONDUCTING THREE RESEARCH STUDIES PERTAINING TO THE MANDATORY SEATBELT USAGE LEGISLATION.

by OLE DUE  
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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P70-1  
1977  
Availability: IN HS-023 250

HS-023 258

#### EFFECT OF MANDATORY SEAT BELT LEGISLATION IN DENMARK, WITH SPECIAL REGARD TO MINOR AND MODERATE INJURY

THE AREA OF 230,000 RESIDENTS COVERED BY ODENSE UNIV. HOSPITAL (DENMARK) WAS STUDIED TO INVESTIGATE THE EFFECT OF MANDATORY SEATBELT USAGE LEGISLATION, EFFECTIVE 1 JAN 1976, ON THE NUMBER AND SEVERITY OF TRAFFIC ACCIDENT INJURIES. THE LAW BROUGHT ABOUT AN INCREASE IN SEATBELT USAGE FROM 20% TO 72% FOR THE STUDY PERIODS. THE NUMBER OF INJURED CAR OCCUPANTS, FRONT-SEAT AND BACK-SEAT PASSENGERS, WAS ANALYZED FOR THE SUMMER MONTHS OF 1975 AND 1976. THE NUMBER OF DAYS A PERSON WAS INCAPACITATED AS A RESULT OF A TRAFFIC INJURY WAS CALCULATED FOR BOTH MINOR AND MODERATE INJURIES. THE ANALYSIS SHOWED A DECLINE FROM 244 FOR THE PERIOD BEFORE TO 211 CASUALTIES FOR THE PERIOD AFTER THE LEGISLATION WAS ENACTED, CORRESPONDING TO AN 18% DECLINE IN THE NORMALLY EXPECTED RATE. MOREOVER, THE INJURIES WERE LESS SEVERE AS AN AVERAGE AFTER THE LEGISLATION WAS IN EFFECT, AND THERE WAS A 30% DECREASE IN NUMBER OF DAYS OF INCAPACITATION. ALSO STUDIED WERE HOSPITAL RECORDS DATING BACK TO FEB 1971 CONCERNING FRONT-SEAT OCCUPANTS INJURED IN TRAFFIC ACCIDENTS (2359 DRIVERS AND 1080 PASSENGERS). ABOUT 10% OF THESE OCCUPANTS HAD BEEN BELTED, AND AN ANALYSIS OF THIS GROUP SHOWED THE HIGH PROTECTIVE EF-

FECT OF THE BELT AGAINST HEAD INJURIES, NO INDICATION OF AN ADVERSE EFFECT ON THORACIC OR ABDOMINAL STRUCTURES. IN THIRD STUDY, A PRELIMINARY INVESTIGATION, ASPECTS OF IMPROPER WEARING OR FITTING BELTS AND OF CAR DESIGN, WHICH CAN BE ALTERED SIMPLY IN THE FUTURE, ARE OUTLINED

by ERIK L. NORDENTOFT; H. V. NIELSEN; E. ERIKSEN; R. WEETH  
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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P72-9  
1977; 4REFS  
Availability: IN HS-023 250

HS-023 259

#### ATTITUDES TOWARDS, AND EFFECTIVENESS MANDATORY SEAT BELT LEGISLATION IN CANADA

PUBLIC OPINION TOWARD AND THE EFFECTIVENESS OF MANDATORY SEATBELT USAGE LEGISLATION WERE INVESTIGATED FOR THE CANADIAN PROVINCES OF ONTARIO AND QUEBEC. FAVORABILITY TO LEGISLATION WAS MEASURED IN NOV 1975 BEFORE ANY ANNOUNCEMENT OF THE LEGISLATION HAD BEEN MADE, IN DEC 1975 AFTER THE LAW WAS ANNOUNCED IN ONTARIO, IN APR 1976 AFTER THE LAW WAS ANNOUNCED IN QUEBEC AND FORCED IN ONTARIO (1 JAN 1976), AND IN SEP 1976 AFTER THE LAW WAS ENACTED IN QUEBEC. THERE WAS NO SIGNIFICANT CHANGE IN FAVORABILITY IN ONTARIO FROM DEC 1975 TO APR 1976 BUT A SIGNIFICANT INCREASE FROM APR TO SEP. IN QUEBEC, HOWEVER, THERE WAS A SIGNIFICANT DECREASE FROM DEC 1975 TO APR 1976. MANDATORY SEATBELT USAGE LEGISLATION HAS RESULTED IN AN INCREASE IN SEATBELT USE AND A CORRESPONDING DECREASE IN INJURIES BUT A RATHER INCONSIDERATE DECREASE IN FATALITIES. SEVERAL EXPLANATIONS HAVE BEEN PUT FORWARD REGARDING THE LACK OF A CONTINUING REDUCTION IN FATALITIES. FIRST, AND MOST OBVIOUSLY, PEOPLE ARE NOT WEARING THEIR BELTS. SECOND, BELTS ARE NOT BEING WORN PROPERLY. AND, THIRD, PEOPLE WHO DISOBEDIENCE THE SEATBELT LAW MAY BE MORE LIKELY TO BE INVOLVED IN ACCIDENTS. SEVERAL PROBLEMS WITH THE SEAT BELTS THEMSELVES HAVE BECOME EVIDENT SINCE THE ENACTMENT OF THE LEGISLATION AND INCLUDE THE FOLLOWING: NONFITTING BELTS, IGNORANCE OF THE VEHICLE'S SENSITIVE LOCKING RETRACTOR, RESTRICTION OF THE INDIVIDUAL FROM REACHING CONTROL PANELS, PRE-1974 UPPER TORSO RESTRAINTS, RUBBING OF THE SIDE OF THE NECK BY THE SHOULDER IN THE TIGHTENING OF BELT-SENSITIVE LOCKING RETRACTORS OVER BUMPY ROADS, AND PROBLEMS WITH BELT SYSTEMS COMBINING BOTH AUTOMATIC LOCKING RETRACTORS AND EMERGENCY LOCKING RETRACTORS. SEATBELT USAGE RATES STILL SEEM TO BE LOW, AND LAW ENFORCEMENT REGULATIONS SEEM TO BE THE MOST LIKELY CAUSE OF THIS SITUATION. FINALLY, IT IS SUGGESTED THAT

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INTRODUCTION AND PASSAGE OF MANDATORY SEATBELT USAGE LEGISLATION SHOULD BE DONE QUICKLY IN ORDER TO PRESERVE PUBLIC FAVORABILITY.

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HS-023 260

#### THE EFFECT OF COMPULSORY SEAT BELT USE IN NEW SOUTH WALES, AUSTRALIA

DURING THE FIRST FULL YEAR (1972) OF NEW SOUTH WALES' (AUSTRALIA) MANDATORY SEATBELT USAGE LEGISLATION, EFFECTIVE NOV 1971, THE NUMBER OF PEOPLE KILLED IN CARS WAS 25% BELOW THE NUMBER NORMALLY EXPECTED. HOWEVER, THAT PERCENTAGE DECREASE IN TRAFFIC FATALITIES HAS NOT CONTINUED IN SUBSEQUENT YEARS BUT HAS REMAINED AT ABOUT 20%. IN ROUND FIGURES, A TOTAL OF APPROXIMATELY 1000 LIVES HAVE SO FAR BEEN SAVED AS A RESULT OF THIS SEATBELT USE LAW. THE MOST COMMON QUESTIONS ASKED CONCERNING THE LAW INCLUDE DOUBTS ON THE EXEMPTION PROVISIONS, PROBLEMS OF ENFORCEMENT, AND OTHER PROBLEMS RELATED TO MECHANICAL DEFICIENCIES WITH THE SEAT BELTS THEMSELVES. EXEMPTIONS (PERSONS WITH CERTIFIED MEDICAL PROBLEMS PRECLUDING WEARING OF SEAT BELTS, TAXI DRIVERS AND PASSENGERS, AND OCCUPANTS OF HEAVIER VEHICLES) HAVE NOT PROVED TO BE MUCH OF A PROBLEM. SIMILARLY, ENFORCEMENT IS TAKEN SERIOUSLY BY TRAFFIC POLICE AND THE LEVEL OF COMPLIANCE HAS TENDED TO CREEP UPWARDS. ALSO, RESEARCH HAS NOT SHOWN SEAT BELTS TO OFFER ANY SPECIAL RISK TO THE Wearer. WHILE, ESPECIALLY IN THE EARLY DAYS, SOME INSTALLATIONS WERE LESS THAN IDEAL, THE GENERAL STANDARD OF SEATBELT DESIGN AND INSTALLATION IN AUSTRALIA HAS IMPROVED MARKEDLY. SEAT BELTS THEMSELVES ARE RESPONSIBLE FOR ONLY A FEW INJURIES, AND USUALLY MINOR ONES.

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1977  
Availability: IN HS-023 250

HS-023 261

#### VICTORIAN EXPERIENCE WITH THE COMPULSORY WEARING OF SEAT BELTS [AUSTRALIA]

VICTORIA'S (AUSTRALIA) COMPULSORY SEATBELT USAGE LEGISLATION, EFFECTIVE 22 DEC 1970, REQUIRES USE OF SEAT BELTS BY CAR PASSENGERS OCCUPYING SEATS FITTED WITH BELTS. THE FOLLOWING PERSONS ARE EXEMPTED FROM WEARING SEAT BELTS: PERSONS ENGAGED IN DRIVING A CAR IN REVERSE, PERSONS WITH A CERTIFIED MEDICAL PROBLEM PRECLUDING WEARING OF SEAT BELTS, PERSONS ENGAGED IN MAKING DELIVERY OF FOOD PRODUCTS AND TRAVELING IN A MOTOR VEHICLE AT A SPEED OF NOT MORE THAN 15 MPH, AND PERSONS ENGAGED IN DRIVING A MOTOR VEHICLE EXCEEDING 10,000 LBS GVW. SEATBELT ANCHORAGES FOR THE DRIVER AND OUTBOARD FRONT-SEAT PASSENGER HAVE BEEN REQUIRED IN VICTORIA FOR NEW CARS SINCE 1 OCT 1964. BY MID 1970, SEAT BELTS WERE FITTED TO ABOUT 60% OF FRONT SEATS, AND ABOUT ONE FOURTH OF THESE WERE BEING WORN. FURTHER LEGISLATION (AUSTRALIAN DESIGN RULES NOS. 4 AND 5A) REQUIRES BELTS TO BE FITTED TO ALL SEATING POSITIONS IN NEW CARS AND OTHER VEHICLES UNDER 10,000 LBS GVW FROM 1 JAN 1971; THESE RULES REQUIRE THE OUTBOARD-POSITION BELTS IN BOTH FRONT AND REAR SEATS TO PROVIDE UPPER TORSO RESTRAINT. MORE RECENT LEGISLATION REQUIRES RETROFITTING OF BELTS IN OLDER CARS. SURVEYS SINCE MAY 1971 HAVE SHOWN THAT WHILE FITTING AND USAGE RATES ARE SOMEWHAT LOWER IN THE COUNTRY THAN IN MELBOURNE, BOTH RATES HAVE BEEN INCREASING STEADILY THROUGHOUT THE STATE. THE LEGISLATION HAS RESULTED IN AN IMMEDIATE AND A SUSTAINED DROP IN VEHICLE OCCUPANT DEATHS, WHILE THERE HAS BEEN NO CORRESPONDING DROP IN THE TOTAL OF ALL OTHER ROAD USER DEATHS. A SIMILAR TREND EXISTS FOR TRAFFIC INJURIES, BUT WITH EVEN LARGER REDUCTIONS. THE TOTAL REDUCTION IN VEHICLE OCCUPANT DEATHS FROM 1971 TO 1976 IS OVER 1400. ALSO TO BE TAKEN INTO CONSIDERATION IN THE TRAFFIC CASUALTY REDUCTIONS, BESIDES THE COMPULSORY SEATBELT USE LAW, IS A SERIES OF ROAD SAFETY INITIATIVES INTRODUCED OVER THE PAST FEW YEARS BY THE GOVERNMENT. FINALLY, IN JAN 1976 LEGISLATION WAS PASSED REQUIRING CHILDREN UNDER EIGHT YEARS OF AGE AND TRAVELING IN THE FRONT SEATS OF CARS TO WEAR AN APPROVED CHILD RESTRAINT. PRELIMINARY RESULTS FOR THE FIRST NINE MONTHS OF 1976 SHOW 384 CASUALTIES OF CHILD PASSENGERS UNDER SEVEN YEARS OF AGE, COMPARED WITH 436 CASUALTIES OVER THE SAME PERIOD IN 1975.

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1977; 7REFS  
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## **WEARING OF SEAT BELTS [AUSTRALIA]**

TRAFFIC INJURY STATISTICS WERE COLLECTED FOR QUEENSLAND (AUSTRALIA) AND ANALYZED TO EVALUATE THE EFFECT OF THE STATE'S COMPULSORY SEATBELT USAGE LEGISLATION WHICH CAME INTO EFFECT 1 JAN 1972. FIRST, A COMPARISON WAS MADE OF TRAFFIC INJURY CASES ADMITTED TO HOSPITALS OR KILLED IN METROPOLITAN BRISBANE DURING 16 MONTHS IN 1962 AND 1963 (1000 CASES EXAMINED), SEVEN WEEKS IN NOV AND DEC 1971 (232 CASES), AND DEC 1972 AND JAN 1973 (283 CASES). THE FOLLOWING SEATBELT USAGE RATES WERE DETERMINED: 0.4% (1962-1963); 6.0% (1971); AND 29.0% (1972-1973). THE RESULTS INDICATE A CHANGE CONSISTENT WITH THE KNOWN INCREASE IN THE WEARING RATE BY OCCUPANTS OF VEHICLES WHERE SEAT BELTS WERE FITTED (THEREFORE COVERED BY THE LEGISLATION). EXCEPT FOR CHEST AND ABDOMINAL OR PELVIC INJURIES AMONG SURVIVORS, AND MINOR HEAD INJURIES, THE INCIDENCE OF INJURIES WAS GREATER WHEN BELTS WERE NOT WORN, SIGNIFICANTLY SO IN THE CASE OF MAJOR HEAD INJURIES. A COMPARISON OF THE EARLIEST STUDY PERIOD WITH THE LATTER TWO WITH REGARD TO MAJOR INJURIES SHOWED THAT CASES IN THE FIRST PERIOD SUSTAINED 1.86 REGIONAL INJURIES PER VICTIM, WHILE THE FOLLOWING 515 CASES SUSTAINED 1.44 PER VICTIM. MORTALITY RATES DROPPED FROM 18.8% TO 14.6%. A SECOND STUDY ANALYZED TRAFFIC INJURY STATISTICS FOR QUEENSLAND FOR THE YEAR ENDED 30 JUN 1973; DATA WERE OBTAINED FROM POLICE ACCIDENT REPORTS. HAD ALL OF THE PERSONS STUDIED (EXCLUDING CASES NOT APPLICABLE AND NOT RECORDED) WORN SEAT BELTS AND HAD THEY STILL BEEN INJURED TO THE SAME DEGREE AS THOSE WHO DID WEAR THEM, ONLY 19 DRIVERS AND 85 PASSENGERS WOULD HAVE DIED, REPRESENTING A SAVING OF 67 DRIVERS' AND 56 PASSENGERS' LIVES. THUS, THE TOTAL DEATHS FOR THE STUDY PERIOD WOULD HAVE BEEN REDUCED FROM 328 TO 204, A SAVING OF 37%-38%. IN ADDITION, THE SEVERITY OF MOST REGIONAL INJURIES WAS REDUCED BY BELTS AND NO CATEGORY OF INJURY WAS INCREASED IN SEVERITY BY THEIR PRESENCE.

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1977; 3REFS  
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HS-023 263

## **SOUTH AUSTRALIAN EXPERIENCE WITH THE COMPULSORY WEARING OF SEAT BELTS**

COMPULSORY FITTING OF SEAT BELTS IN NEW VEHICLES WAS INTRODUCED IN JAN 1967, BUT SUB-

WAS ENACTED IN NOV 1971. USAGE BY VEHICLE OCCUPANTS WITH BELTS FITTED IN THEIR CARS ROSE IN THE ADELAIDE METROPOLITAN AREA FROM 36% IN OCT 1971 TO 78% IN OCT 1972, WITH VIRTUALLY NO POLICE ENFORCEMENT. THEN A GRADUAL DECLINE TOOK PLACE, WITH A 66% USAGE RATE IN OCT 1975. A LARGE INCREASE IN USAGE OCCURRED AFTER THE INTRODUCTION OF AN INTENSIVE ENFORCEMENT PROGRAM BY THE SOUTH AUSTRALIAN POLICE DEPT. IN MID 1976 WHEN USAGE ROSE TO 84%. THIS INCREASE WAS EVEN MORE OBVIOUS IN THE CASE OF DRIVERS WITH AVAILABLE SEATBELTS WHERE USAGE ROSE FROM 70% IN 1975 TO 90% IN 1976. THE USE OF INERTIA-REEL SEAT BELT HAS ALSO CONTRIBUTED TO THE INCREASE IN WEARING RATE. THE INCREASE IN SEATBELT USAGE WAS ACCOMPANIED BY A SUBSTANTIAL DECREASE IN VEHICLE OCCUPANT FATALITIES. THERE WERE 196 VEHICLE OCCUPANT DEATHS IN 1976 COMPARED WITH 228 IN 1975, I.E. A DROP OF 14%.

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AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P125-9  
1977; 4REFS  
BASED ON "A REVIEW OF SEAT BELT USAGE IN  
SOUTH AUSTRALIA 1964-1971" (ROAD TRAFFIC BOARD  
OF SOUTH AUSTRALIA), AND "THE EFFECT ON  
CASUALTIES OF A COMPULSORY SEAT BELT  
WEARING LAW IN SOUTH AUSTRALIA," BY J. D.  
CRINION, L. A. FOLDVARY, AND J. C. LANE.  
Availability: IN HS-023 250

HS-023 264

## **COMPULSORY SEAT BELT WEARING IN WESTERN AUSTRALIA**

A CHRONOLOGICAL DESCRIPTION IS GIVEN OF THE EVENTS LEADING UP TO THE INTRODUCTION OF LEGISLATION REQUIRING USAGE OF SEAT BELTS IN WESTERN AUSTRALIA AS OF 24 DEC 1971, AND EXPERIENCE WITH THE LAW TO DATE IS DISCUSSED. THE VARIOUS SEATBELT WEARING REGULATIONS ARE APPENDED. AS EARLY AS SEP 1962 THE GOVERNMENT SET AN EXAMPLE BY FITTING THEIR VEHICLES WITH SEAT BELTS AND BY REQUIRING THE WEARING OF SEAT BELTS BY EMPLOYEES. IN BOTH NOV 1968 AND MAY 1970 THE NATIONAL SAFETY COUNCIL MADE RECOMMENDATIONS TO THE GOVERNMENT REGARDING THE COMPULSORY FITTING OF SEAT BELTS IN VEHICLES AND THE WEARING OF SEAT BELTS BY OCCUPANTS. THE ROLE OF THE NEWSPAPERS IN THE INTRODUCTION OF COMPULSORY SEATBELT USAGE LEGISLATION WAS CONSIDERED TO BE VERY IMPORTANT. REGULAR INFORMATION ON SEATBELT USAGE BY PERSONS KILLED OR INJURED IN POLICE-REPORTED TRAFFIC ACCIDENTS WAS PUBLISHED MONTHLY BY THE PRESS DURING 1971. FIGURES PUBLISHED BY THE PRESS, TOGETHER WITH CORRESPONDING

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DATA FOR THE FIRST FOUR YEARS THE LEGISLATION HAS BEEN IN EFFECT, ARE TABULATED. THESE DATA INDICATE THAT PERSONS WEARING SEAT BELTS WERE FAR LESS LIKELY TO BE KILLED OR INJURED THAN NONWEARERS. A COMPARISON OF THE PERCENTAGE OF VEHICLES FITTED WITH SEAT BELTS INVOLVED IN POLICE-REPORTED ACCIDENTS DURING 1975 AND THE PERCENTAGE OF VEHICLES FITTED WITH SEAT BELTS ON REGISTER AS OF 1 JAN 1976 SHOWS NO NOTICEABLE DIFFERENCE. STATISTICS FOR 1974-1975 SHOW THAT MOST MOTORISTS PAID THE \$20 FINE IMPOSED FOR THEIR NOT WEARING A SEAT BELT. AS OF 8 OCT 1976 THE PENALTY WAS REDUCED TO \$10 BECAUSE IT WAS FOUND THAT POLICE WERE RELUCTANT TO IMPOSE A \$20 FINE FOR WHAT THEY REGARDED AS AN OVERSIGHT RATHER THAN A DELIBERATE OFFENSE.

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#### FIFTEEN YEARS WITH THE THREE-POINT SAFETY BELT. A REVIEW OF THE DEVELOPMENT AND EXPERIENCE OF CAR OCCUPANT RESTRAINT [SWEDEN]

THE VOLVO THREE-POINT SAFETY BELT HAS BEEN CONTINUOUSLY STUDIED AND EVALUATED SINCE 1959 WHEN THE HARNESS-TYPE BELT FIRST BECAME STANDARD EQUIPMENT (FOLLOWED BY THE RETRACTOR BELT IN 1973). MANDATORY SEATBELT USAGE LEGISLATION CAME INTO EFFECT IN SWEDEN ON 1 JAN 1975. THE USAGE RATE FOR THOSE REQUIRED TO WEAR BELTS (FRONT-SEAT PASSENGERS, EXCLUDING CHILDREN UNDER 14, TAXI DRIVERS, AND THOSE HAVING CERTAIN MEDICAL PROBLEMS) HAS INCREASED FROM ABOUT 25% IN 1965-1966 TO OVER 90% IN 1975. BELT USAGE IN REAR SEATS WAS ONLY ABOUT 6% IN 1975. THE PERCENTAGE REDUCTION IN TRAFFIC INJURIES BECAUSE OF SEATBELT USE HAS BEEN DETERMINED TO BE 24% FOR AIS (ABBREVIATED INJURY SCALE) 1-6 INJURIES, AND 68% FOR AIS 3-6 INJURIES. ANALYSIS OF ACCIDENT DATA FOR ACCIDENTS INVOLVING VOLVOS WHICH OCCURRED IN SWEDEN DURING 1974 AND 1975 AND PART OF 1976 SHOW THAT THE AIS 1-6 INJURIES FOR DRIVERS DECREASED FROM 33% TO 29%, AND FOR FRONT-SEAT PASSENGERS FROM 38% TO 29%, AFTER THE LEGISLATION WAS IN EFFECT. ALSO, THE AIS 3-6 INJURIES DECREASED FROM 2.34% TO 1.29% FOR DRIVERS. NO SIGNIFICANT DIFFERENCE IN THE MEAN EFFECTIVENESS FIGURES FOR RETRACTOR AND NON-RETRACTOR TYPES OF BELTS WAS FOUND. A JOINT EFFORT BY VOLVO AND WAYNE UNIV. (MICHIGAN) SEVERAL YEARS AGO INVESTIGATED HUMAN TOLERANCE DURING FRONTAL IMPACTS IN VOLVO 140/164 VEHICLES EQUIPPED WITH THREE-POINT HARNESSSES. THE SIMULATED AND STAGED COLLIS-

SIONS, UP TO 53 MPH BEV (BARRIER EQUIVALENT VELOCITY), DEMONSTRATED THE FOLLOWING: EFFECTIVENESS OF THREE-POINT HARNESS IN MITIGATING INJURY; NO INJURIES TO ABDOMINAL ORGANS (EXCEPT ONE CASE OF RUPTURED SPLEEN); RIB AND STERNUM FRACTURES MOST COMMON INJURY; FEMALES INJURED AT LOWER SPEEDS THAN MALES (FEMALES RECEIVING RIB FRACTURES AT 20.6 MPH BEV VS. 34.6 MPH BEV FOR MALES); AGE AS A MAJOR FACTOR IN THE POTENTIAL FOR INJURIES BY BELT SYSTEMS; HIC (HEAD INJURY CRITERIA) NOT A RELEVANT CRITERION; ABDOMINAL AND/OR TORSO INJURIES ATTRIBUTABLE TO SUBMARINING NOT A MAJOR PROBLEM; AND OVERALL TOLERANCE LEVEL OF AID 3 FOR THREE-POINT SAFETY BELT, BASED UPON 50% INJURY RATE, OCCURRING AT 45 MPH BEV.

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HS-023 266

#### SEAT BELT EFFECTIVENESS IN URBAN CRASHES [AUSTRALIA]

THE FIRST 100 CASES INVESTIGATED IN A CONTINUING IN-DEPTH STUDY OF TRAFFIC ACCIDENTS IN ADELAIDE, SOUTH AUSTRALIA CONCERNING THE USE AND EFFECTIVENESS OF SEAT BELTS IN PASSENGER CARS FORM THE BASIS OF THIS DISCUSSION. THE CRITERION FOR THE SELECTION OF A CASE IS THAT AN AMBULANCE HAS BEEN CALLED, AND NOT THE TYPE OR SEVERITY OF THE CRASH. CONSEQUENTLY, 13 OF THESE ACCIDENTS DID NOT INVOLVE A PASSENGER CAR, AND ABOUT ONE FIFTH OF THE TOTAL DID NOT RESULT IN ANY SIGNIFICANT INJURY. NO CAR OCCUPANT WAS FATALLY INJURED, BUT SOME INJURIES WERE SUCH THAT SURVIVAL WOULD HAVE BEEN UNCERTAIN HAD THE CRASH OCCURRED IN A RURAL AREA REMOTE FROM SKILLED EMERGENCY CARE. BELT USAGE IN URBAN ACCIDENTS WAS FOUND TO BE LOWER AT NIGHT, AND SO ASSOCIATED WITH ABOVE-AVERAGE IMPACT SEVERITIES. APART FROM THE IMMEDIATE CONSEQUENCES TO THE NONBELT WEARERS, THIS MAY ARTIFICIALLY DEFLATE ESTIMATES OF THE EFFECTIVENESS OF SEAT BELTS IN INJURY REDUCTION IF THEY ARE BASED ON DAYTIME OBSERVATION OF WEARING RATES. THREE CASE STUDIES, MATCHED FOR CRASH TYPE AND SEVERITY, HAVE DEMONSTRATED THAT A CORRECTLY ADJUSTED SEAT BELT CAN TRANSMIT INERTIA LOADINGS IN A MANNER WHICH GREATLY REDUCES THE SEVERITY OF, OR EVEN ELIMINATES ALTOGETHER, THE INJURIES WHICH WOULD OTHERWISE BE SUSTAINED. IT WAS FOUND THAT THE BELT SYSTEM IN USE IN AUSTRALIA TODAY CAN, UNDER CERTAIN CIRCUMSTANCES, FAIL TO ENSURE EFFECTIVE RESTRAINT. SOME REVISION (E.G. INCORPORATION OF A LOCKING RETRACTOR ON THE

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SPONSORED BY COMMONWEALTH DEPT. OF  
TRANSPORT (AUSTRALIA) AND AUSTRALIAN ROAD  
RES. BOARD.  
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### THE EFFECTIVENESS OF BELT SYSTEMS IN FRONTAL AND ROLLOVER CRASHES

THE PASSENGERS INVOLVED IN FRONTAL AND ROLLOVER CRASHES WERE EITHER LAP BELTED, LAP-SHOULDER BELTED, OR UNRESTRAINED. IN THE FRONTAL CRASH THE LAP-SHOULDER BELT REDUCED THE OCCURRENCE OF THE SEVERE, SERIOUS, CRITICAL-TO-LIFE INJURIES, AND FATALITIES, FOR ALL REGIONS OF THE BODY (HEAD, NECK, THORAX, LOWER TORSO, AND EXTREMITIES). IN ADDITION, A STRONG ASSOCIATION BETWEEN BELT USAGE AND THE OCCUPANT ESCAPING FROM THE CRASH WITH NO INJURY WAS FOUND. IN ROLLOVER CRASHES, BELTS REDUCED THE FREQUENCY OF THE MORE SEVERE INJURIES BY PREVENTING THE OCCUPANT FROM BEING EJECTED. FOR THOSE OCCUPANTS NOT EJECTED FROM THE CAR, BELTS EFFECTIVELY REDUCED FATALITIES AND THE MORE SERIOUS INJURIES. AIS (ABBREVIATED INJURY SCALE) FREQUENCIES BY BODY REGIONS FOR THE TWO TYPES OF CRASHES AND BY PROTECTION AFFORDED PASSENGERS ARE TABULATED.

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1977; IREF  
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### SEAT BELTS AND ANCHORAGES - AUSTRALIAN DESIGN RULES [LEGISLATION]

FOLLOWING A BRIEF OUTLINE OF THE OPERATION OF THE AUSTRALIAN DESIGN RULE (ADR) SYSTEM IN WHICH THE COUNTRY'S SEATBELT SPECIFICATIONS ARE EMBODIED, THE DEVELOPMENT OF SEAT BELTS AND ANCHORAGES IN AUSTRALIA IS REVIEWED. THE FIRST SEATBELT RULES, ADR 4 (SPECIFICATIONS FOR SEAT BELT ASSEMBLY STRENGTH UNDER A STATIC TEST, RESISTANCE TO

STRUCTURES FOR USE) AND ADR 5A (SPECIFICATIONS FOR NUMBER OF SEATING POSITIONS TO BE FITTED WITH BELTS, THE TYPE OF BELT TO BE FITTED, AND THE STRENGTH OF AND LOCATION FOR ANCHORAGES), CAME INTO EFFECT ON 1 JAN 1969 AND APPLIED ONLY TO THE FRONT SEATS OF PASSENGER CARS AND DERIVATIVES (IN JAN 1971, CHANGED TO INCLUDE REAR SEATS). SINCE THAT TIME, ADR 4 HAS BEEN UPGRADED AND APPLIED TO OTHER VEHICLE TYPES (ADR 4A, JAN 1974 (PASSENGER CARS AND DERIVATIVES, MULTIPURPOSE PASSENGER CARS) AND JUL 1974 (OTHER VEHICLES LESS THAN 4.5 TON GVW); ADR 4B (JAN 1975 AND JUL 1975); AND ADR 4C (JAN 1976 AND JUL 1976)). ADR 5A WAS UPGRADED TO ADR 5B IN JAN 1975 AND JUL 1975 (APPLIED TO VEHICLES LESS THAN 4.5 TON GVW). ON 1 JUL 1977, A NEW ADR, ADR 32, WAS ENACTED WHICH REQUIRES THE FITTING OF SEATBELTS IN THE DRIVER POSITION OF BUSES AND HEAVY COMMERCIAL VEHICLES, AND THE OUT-BOARD FRONT-SEAT PASSENGER POSITION IN TRUCKS. A UNIQUE RULE, ADR 34, WHICH WAS ENACTED IN JUL 1976 REQUIRES THE PROVISION OF ANCHORAGE POINTS FOR CHILD RESTRAINTS IN PASSENGER CARS. A NUMBER OF WAYS IN WHICH THE PERFORMANCE OF THE PRESENT SEATBELT SYSTEM MIGHT BE IMPROVED ARE OUTLINED, TOGETHER WITH OTHER ASPECTS WHICH REQUIRE INVESTIGATION OR FURTHER ACTION, AND INCLUDE THE FOLLOWING: UNIFORM BUCKLE LATCHING AND RELEASE; STANDARD MEANS OF ADJUSTMENT ON NONRETRACTOR BELTS; SEATBELTS ATTACHED TO SEATS; LACK OF PROTECTION OF A SEATBELT WEARER'S HEAD; PROBLEM OF VEHICLE INTRUSION FOR THE SEATBELT WEARER; POSSIBLE NEED FOR DESIGNS TO LIMIT PEAK FORCE AND CONTACT PRESSURE EXERTED BY BELT; EFFECT OF USAGE ON SEAT BELT STRENGTH; INTERNATIONAL UNIFORMITY OF VEHICLE STANDARDS; AND PASSIVE RESTRAINT SYSTEMS.

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1977  
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### RECENT AND FUTURE IMPROVEMENTS IN SEAT BELT DESIGN [GERMANY]

DAIMLER-BENZ HAS CONTRIBUTED TO SEATBELT DESIGN PROGRESS FOR MORE THAN 20 YEARS. BESIDES AMPLIFICATION OF BASIC PROTECTION, CONTINUOUS EFFORT HAS BEEN MADE TO IMPROVE BELT CHARACTERISTICS WHICH WILL PROMOTE PASSENGER ACCEPTANCE OF SEAT BELTS (I.E. THREE-POINT SAFETY BELT INTEGRATED INTO THE MID-DOOR PILLAR, BUCKLE TONGUE AND SASH GUIDE DESIGNED TO EASE BELT APPLICATION AND

REMOVAL, RETRACTOR WITH COMFORT ZONE, LOCATION AND DESIGN OF BELT ANCHORAGES, AND BELT PRETENSIONERS DESIGNED TO ELIMINATE BELT SLACK). A PRELIMINARY SET OF SPECIFICATIONS, AS WELL AS POSSIBLE DESIGN SOLUTIONS FOR PRETENSIONERS, ARE PRESENTED. TEST RESULTS SHOW THAT IN SOME CASES IMPACT LOADS ON CAR OCCUPANTS CAN BE REDUCED BY ONE HALF. FOR THE DRIVER, AN AIR BAG IN THE STEERING WHEEL IS CONSIDERED AN APPROPRIATE SUPPLEMENT TO A CONVENTIONAL THREE-POINT BELT. CONFIRMATIVE FLEET TESTING OF THESE NEW SYSTEMS ON THE ROAD IS NEEDED. AN OPTIMUM CHILD RESTRAINT HAS BEEN DEVELOPED AND IS ILLUSTRATED.

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977

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HS-023 270

#### **RECENT IMPROVEMENT IN SEAT BELT DESIGN AUSTRALIA]**

UNDoubtedly, THE MOST SIGNIFICANT IMPROVEMENT WHICH HAS BEEN MADE BY AUSTRALIA AUTO MANUFACTURERS HAS BEEN THE INTRODUCTION OF EMERGENCY LOCKING RETRACTORS. THEY PROVIDE FREEDOM OF MOVEMENT DURING NORMAL VEHICLE OPERATION, DO NOT REQUIRE COMPLICATED OR DIFFICULT OPERATIONS TO BE CORRECTLY WORN WITHOUT SLACK, AND AUTOMATICALLY STOW AWAY AFTER USE. RECENT DESIGN IMPROVEMENTS HAVE RESULTED IN A REDUCTION OF WEBBING PAYOUT BY PARTICULAR ATTENTION TO THE MECHANISMS UTILIZED TO LOCK THE REEL SPINDLE. ALSO, ELONGATION HAS BEEN REDUCED FROM 20% DOWN TO 13% BY SELECTION OF YARN AND WEAVING TECHNIQUE, AND RETRACTING FORCE HAS BEEN REDUCED FROM 10.0N TO 2.5N. IN ADDITION, THE IN-SERVICE DURABILITY OF THE RETRACTORS HAS IMPROVED STEADILY SO THAT A LIFE CYCLE TWICE THAT OF THE LEGAL REQUIREMENTS IS SPECIFIED. IMPROVEMENTS IN THE ELONGATION (NOW AT 13%) AND HYSTERESIS (AT 80%) OF THE WEBBING HAVE BEEN ACCCOMPANIED BY A RESTORATION OF THE FLEXIBILITY, RESULTANT COMFORT, AND IMPROVED STOWING PERFORMANCE LOST WHEN THE WEBBING WAS MADE MORE ABRASION-RESISTANT. RECENT DESIGN IMPROVEMENTS IN STALKS ENSURE THAT THE BELT IS COMFORTABLE TO WEAR AND THAT SLACK IS ELIMINATED BY ALLOWING THE BUCKLE TO REST ON THE WEARER'S HIP, WHILE STILL MAINTAINING SUFFICIENT RIGIDITY TO ENSURE THAT THE BUCKLE DOES NOT GET TRAPPED IN THE SEAT OR ON THE FLOOR. CONCERNING BUCKLES, CURRENT SEAT BELT DESIGNS PREVENT FALSE LATCHING BY INCORPORATING EJECTOR SPRINGS FOR THE TONGUE COUPLED WITH INTERNAL SNAP-TYPE LATCHES WHICH ARE EITHER IN OR OUT OF ENGAGEMENT

AND NOT HALF WAY IN BETWEEN. ALTHOUGH STATIC BELTS ARE NO LONGER USED IN THE FRONT SEATS OF VEHICLES IN AUSTRALIA, THEY HAVE BENEFITTED FROM SIMILAR IMPROVEMENTS AS WELL AS IMPROVEMENTS IN STOWAGE AND BETTER DESIGNED MANUAL LENGTH ADJUSTERS. TO ACHIEVE THE GREATEST BENEFIT FROM A SEAT BELT SYSTEM, THE VEHICLE ENVIRONMENT IS EQUALY AS IMPORTANT AS THE HARDWARE OF THE SEAT BELT ITSELF, AND MUCH ATTENTION HAS BEEN GIVEN TO DESIGN IMPROVEMENTS IN THE VEHICLE INSTALLATION.

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#### **A SURVEY OF THE UTILIZATION OF SAFETY RESTRAINTS IN MOTOR VEHICLES BY CHILDREN IN THE BRISBANE AREA [AUSTRALIA]**

THREE SEPARATE SURVEYS WERE CONDUCTED TO INVESTIGATE VARIOUS ASPECTS OF SEATBELT USAGE BY CHILDREN IN THE BRISBANE (QUEENSLAND, AUSTRALIA) AREA. THE FIRST SURVEY WAS OF PARENTS IN EMERGENCY ROOMS OF LOCAL CHILDREN'S HOSPITALS. OVERALL, 41% WERE SAID TO HAVE BEEN RESTRAINED BUT ONLY 21% OF THE CHILDREN WERE USING A RESTRAINT RECOMMENDED FOR THE AGE AND WEIGHT OF THE CHILD. THE MAJORITY OF CHILDREN IN EACH OF THREE AGE GROUPS TRAVELED IN THE BACK SEAT, WITH THE FIVE TO EIGHT YEAR OLD GROUP SHOWING THE GREATEST TENDENCY TO OCCUPY THIS POSITION, AND THE BIRTH TO NINE MONTH OLD GROUP AND THE NINE TO THIRTEEN YEAR OLD GROUP SHOWING THE GREATEST TENDENCY TO OCCUPY THE FRONT SEAT. UNFORTUNATELY THERE IS STILL A WIDE CONSENSUS OF OPINION BY PARENTS THAT ON SHORT TRIPS, A SEAT BELT IS NOT REQUIRED. IT IS FELT THAT SEAT BELTS MAY BE REQUIRED FOR LONG TRIPS, BUT IT IS DIFFICULT TO KEEP CHILDREN IN THE RESTRAINT. IN A SECOND STUDY SURVEYING SEATBELT USAGE AMONG CHILDREN IN CARS OBSERVED AT A BUSY INTERSECTION AND AT A MAJOR SUBURBAN SHOPPING COMPLEX, 12.9% WERE SEEN TO BE RESTRAINED. IN TWO AGE GROUPS (ESTIMATED UNDER EIGHT YEARS OF AGE AND OVER EIGHT YEARS OF AGE), THE MAJORITY OF CHILDREN WERE FOUND TO BE SITTING IN THE BACK SEAT. AS A GENERAL TREND, CHILDREN SITTING IN THE FRONT SEAT WERE MORE LIKELY TO BE RESTRAINED. THE THIRD PART OF THE STUDY WAS A REVIEW OF CHILDREN ATTENDING THE EMERGENCY ROOMS AT LOCAL CHILDREN'S HOSPITALS, FOLLOWING MOTOR VEHICLE ACCIDENTS. ONLY 4.3% WERE FOUND TO HAVE BEEN RESTRAINED; THIS FIGURE DIFFERS MARKEDLY FROM THE OBSERVATION STUDY FIGURE OF 12.9%. THE DISCREPANCY IS DUE TO THE FACT THAT

JURED AND HENCE LESS LIKELY TO BE SEEN AT AN EMERGENCY ROOM.

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#### EVOLUTION OF AUSTRALIAN STANDARD FOR CHILD RESTRAINTS

THE REALIZATION OF THE INADEQUACY OF CHILDREN'S CHAIRS HOOKED OVER THE BACK OF THE FRONT SEAT FOR THE PURPOSES OF CRASH PROTECTION LED TO THE 1970 ISSUE OF THE FIRST AUSTRALIAN STANDARD FOR CHILD RESTRAINTS, AS E46-1970, WHICH SET DESIGN RESTRICTIONS AND PERFORMANCE GOALS FOR DEVICES THOUGHT TO BE SUITED TO CHILDREN OVER THE ENTIRE AGE RANGE FROM BIRTH TO 11 YEARS OF AGE. IT WAS INTENDED TO INCLUDE ALL ESTABLISHED CHILD RESTRAINT SYSTEMS, REPRESENTED BY THE SWEDISH VOLVO REAR-FACING SEAT, THE BRITISH JEENAY FORWARD-FACING SEAT, AND THE AMERICAN FORD TOT-GARD FORWARD-FACING BARRIER TYPE OF ENCLOSURE. IN ADDITION TO THESE RESTRAINTS FOR TODDLERS, THE STANDARD INCLUDED FULL HARNESSSES FOR OLDER CHILDREN AND A SCHEME FOR STRENGTHENING, PADDING, AND SECURING BASSINETS FOR BABIES. IN 1975 THE AUSTRALIAN STANDARD WAS COMPLETELY REWRITTEN. THE CHIEF TECHNICAL CHANGES MADE AND INCLUDED IN AS 1754-1975 WERE THE INCLUSION OF A RANGE OF DYNAMIC TESTS, REQUIREMENTS FOR EASIER ADJUSTMENT OF ALL STRAPS, AND A SIMPLER METHOD FOR SECURING BASSINETS. ALL EXISTING DESIGNS OF CHILD RESTRAINT HAD TO BE UPGRADED IN ORDER TO COMPLY WITH THE NEW REQUIREMENTS. THE STANDARDS ASSOCIATION OF AUSTRALIA HAS APPROVED SEVERAL MAKES OF CHILD SEATS AND SEVERAL HARNESSSES TO AS 1754. IN PRINCIPLE THERE IS NO REASON WHY MANY MORE MAKES SHOULD NOT RECEIVE APPROVAL IF SUBMITTED, BUT OTHERS MAY NEED MODIFICATION. SHORTCOMINGS OF NONAPPROVED FORWARD-FACING BARRIER TYPES OF ENCLOSURES INCLUDE THE POSSIBILITY OF EJECTION OF A CHILD IN ROLLOVER CRASHES AND APPLICATION OF MAIN DECELERATION ON THE ABDOMEN OF THE CHILD. DEVELOPMENT OF REAR-FACING SEATS TO ACCOMPLISH DECELERATION BY DISTRIBUTING THE FORCES OVER THE BACK IS ENCOURAGED. THIS TYPE OF SEAT IS WELL COVERED BY THE AUSTRALIAN STANDARD. THE BRITISH JEENAY SEAT SEEKS TO

FITTED IN THE REAR COMPARTMENT AND LIFT THE CHILD ABOVE THE BENCH SEAT SO THAT HE/SHE CAN SEE WHERE THE CAR IS GOING. THE BENCH SEAT PROVIDES A NATURAL FOOT REST RESTRAINT IN FRONTAL CRASHES IS PROVIDED BY MEANS OF A FULL HARNESS. THE SEAT BACK IS PROVIDED WITH SIDE WINGS WHICH HELP TO CONTAIN THE CHILD'S HEAD IN OFF-LINE FRONTAL AND REAR IMPACTS.

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#### CHILD RESTRAINT SYSTEMS IN SWEDEN

A RESTRAINT SYSTEM FIRMLY ANCHORED TO THE CAR, WITH HARD, NONRECOILING PADDINGS WHICH PLACES THE CHILD IN A REARWARD-FACING DIRECTION WITH RESPECT TO THE DIRECTION OF DECELERATION, AND WHICH SUPPORTS THE ENTIRE BODY SURFACE OF THE CHILD, IS THE MOST EFFECTIVE MEANS OF PROTECTING A CHILD PASSENGER IN ADDITION, THE RESTRAINT SYSTEM SHOULD HAVE THE FOLLOWING PRACTICAL FEATURES EASY TO REMOVE CHILD FROM THE SEAT, INABILITY FOR YOUNG CHILDREN TO CLIMB OUT OF THE RESTRAINT SYSTEM THEMSELVES, EASY INSTALLATION, AND COMFORTABILITY OF SEAT TO THE EXTENT THAT A CHILD SHOULD BE ABLE TO SLEEP IN IT. IN SWEDEN IT IS RECOMMENDED THAT PARENTS BUY A REARWARD-FACING CHILD SEAT AND THAT IT BE USED AS SOON AS THE CHILD IS ABLE TO SIT UP (AT ABOUT SIX MONTHS OF AGE) UNTIL HE/SHE HAS OUTGROWN THE SEAT (FOR MOST SEATS, NORMALLY AT ABOUT AGE FOUR). ONLY REARWARD-FACING SEATS HAVE BEEN APPROVED IN SWEDEN SHOWN BY A SPECIAL APPROVAL SIGN GIVEN TO SEATS WHICH HAVE PASSED THE CRASH TESTS AND HAVE SHOWN GOOD HANDLING QUALITIES PARENTS ARE ADVISED TO AVOID TRANSPORTING THEIR CHILDREN WHO ARE UNDER THE AGE OF SIX MONTHS. IF THEY MUST DO SO, HOWEVER, THEY ARE ADVISED TO USE A STRONG CRADLE STABILIZED MOUNTED TRANSVERSELY IN THE MIDDLE OF THE CAR, DIRECTLY BEHIND THE FRONT SEAT. A SURVEY IN THE SPRING OF 1976 IN LINKOPING, SWEDEN SHOWED THAT OUT OF 1575 PARENTS HAVING CHILDREN UNDER FIVE YEARS OF AGE, 88% OWNED A CAR, AND OF THIS GROUP, AS MANY AS 80% UTILIZED CAR SEATS FOR THEIR CHILDREN (72% WERE REARWARD-FACING SEATS AND 96% WERE INSTALLED IN THE FRONT SEAT). REARWARD-FACING CHILD SEATS WILL PROBABLY BECOME STANDARD WORLDWIDE. NOW IT IS IMPORTANT TO GIVE AT

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FENTION TO THE OLDER CHILD'S PROTECTION, I.E.  
CHILDREN BETWEEN THE AGES OF FOUR AND TEN.

by PETER W. ARNBERG

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THE INTERNATIONAL ASSOCIATION FOR ACCIDENT  
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#### CHILD RESTRAINT USAGE IN MELBOURNE AND CANBERRA: EVALUATION OF VICTORIAN LEGISLATION - A PRELIMINARY ANALYSIS AUSTRALIA]

USING THE RESULTS OF ROADSIDE SURVEYS OF VARIOUS ASPECTS OF THE TRANSPORT OF CHILDREN IN VEHICLES (E.G. SEATING POSITION, AGE, SEX, AND AVAILABILITY AND USAGE OF RESTRAINTS) IN MELBOURNE (VICTORIA) AND CANBERRA (AUSTRALIAN CAPITAL TERRITORY), A BEFORE/AFTER ANALYSIS OF VICTORIA'S LEGISLATION REGARDING THE TRANSPORT OF CHILDREN IN VEHICLES WAS CONDUCTED. CANBERRA PROVIDED CONTROL DATA, THERE BEING NO EQUIVALENT LEGISLATION IN THE AUSTRALIA CAPITAL TERRITORY. LATE IN 1975 THE VICTORIAN PARLIAMENT PASSED LEGISLATION, EMBODIED IN THE MOTOR CAR (CHILD SEAT RESTRAINTS) ACT 1975, RELATING TO CHILDREN RIDING IN VEHICLES. AS OF 17 JAN 1976, A CHILD LESS THAN EIGHT YEARS OF AGE MAY NOT TRAVEL IN THE FRONT SEAT OF A MOTOR CAR (PASSENGER AND PASSENGER-DERIVATIVE VEHICLES HAVING REAR SEATING POSITIONS) UNLESS PROPERLY RESTRAINED BY A CHILD SEAT RESTRAINT THAT IS APPROVED BY THE CHIEF COMMISSIONER OF POLICE AND IS SUITABLE FOR SAFE AND EFFECTIVE USE BY A CHILD OF THE BODY MASS AND HEIGHT OF THE CHILD, OR SEATED AND PROPERLY RESTRAINED BY A SAFETY BELT (CHILD HARNESSSES AND ADULT SEAT BELTS) THAT IS SUITABLE FOR SAFE AND EFFECTIVE USE BY A CHILD OF THE BODY MASS AND HEIGHT OF THE CHILD, AND PROPERLY ADJUSTED AND SECURELY FASTENED. FOLLOWING INTRODUCTION OF THE LEGISLATION THERE HAS BEEN A STATISTICALLY SIGNIFICANT RELOCATION OF CHILDREN LESS THAN EIGHT YEARS OF AGE (MAINLY LESS THAN FIVE YEARS OF AGE) FROM FRONT TO REAR SEATING POSITIONS. OF THE 14% OF CHILDREN STILL LOCATED IN FRONT SEATING POSITIONS, THREE OUT OF FOUR WERE UNRESTRAINED, REFLECTING THE NON-WEARING OF ADULT SEAT BELTS BY CHILDREN AGED FIVE TO SEVEN YEARS AND THE PRACTICE OF NURSING CHILDREN, PARTICULARLY INFANTS LESS THAN TEN MONTHS OF AGE, IN FRONT SEATING POSITIONS. RELOCATION TO REAR SEATING POSITIONS APPARENTLY INCREASES THE PROBABILITY OF BEING RESTRAINED, BUT ONLY FOR CHILDREN LESS THAN FIVE YEARS OF AGE. THE LEGISLATION OBVIOUSLY HAS HAD SOME EFFECT, BUT WHETHER THE SHIFT HAS BEEN SUFFICIENT TO CAUSE A SIGNIFICANT REDUCTION IN THE

NUMBER OF CHILDREN KILLED AND INJURED IN MOTOR VEHICLE ACCIDENTS IS STILL TO BE SHOWN.

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#### FATAL INJURIES TO CHILD OCCUPANTS IN AUTOMOBILE COLLISIONS [SWEDEN]

DATA ARE PRESENTED FOR 62 VEHICLE ACCIDENTS WHICH OCCURRED IN SWEDEN DURING 1973-1975 IN WHICH 65 CHILDREN UNDER THE AGE OF 15 WERE KILLED. OF THE 65 CHILDREN KILLED, ONE WAS BELTED, FOUR WERE IN BABY CARRIERS, AND THREE CHILDREN WERE IN CHILD SAFETY SEATS; THE REMAINING 57 WERE UNBELTED. THE POSITIONS OCCUPIED BY THE FATALITIES WERE AS FOLLOWS: FRONT SEAT, 15 (13 UNRESTRAINED); REAR SEAT, 46 (39 UNRESTRAINED); AND CARGO AREA OF STATION WAGON, FOUR (ALL UNRESTRAINED). INFORMATION PRESENTED WAS DERIVED FROM POLICE ACCIDENT INVESTIGATION REPORTS (AND PHOTOGRAPHS OF DAMAGED VEHICLES), REPORTS FROM HOSPITALS AND CORONERS, AND TELEPHONE CONVERSATIONS WITH PARENTS AND RELATIVES OF THE CHILDREN. APPENDED ARE THE FOLLOWING DATA FOR EACH ACCIDENT: DRAWING OF VEHICLE INVOLVED WITH DAMAGED PART SHADED; MAKE AND MODEL OF VEHICLE; DESCRIPTION OF ACCIDENT; SEATING POSITIONS OF PASSENGERS; PRESENCE OR ABSENCE OF RESTRAINT SYSTEM; AGE AND SEX OF OCCUPANTS; AND TYPE AND SEVERITY (AIS, ABBREVIATED INJURY SCALE) OF INJURIES SUSTAINED BY OCCUPANTS. PHOTOGRAPHS OF VEHICLES INVOLVED IN SEVERAL OF THE ACCIDENTS ARE ALSO PROVIDED.

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PREPARED IN COOPERATION WITH CHALMERS UNIV. OF TECHNOLOGY, GOTHEBURG, SWEDEN, AND INSTITUT VOOR WEGTRANSPORTMIDDELLEN (TNO), DELFT, HOLLAND.

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HS-023 276

#### THE ADULT BELT - A HAZARD TO THE CHILD? [SWEDEN]

SEATBELT USAGE BY 822 CHILDREN INVOLVED IN 683 SERIOUS TRAFFIC ACCIDENTS WHICH OCCURRED

AN INJURY VIEWPOINT. THE VEHICLES IN WHICH THE CHILDREN (UNDER THE AGE OF 15) WERE RIDING WERE VOLVO MODELS 140, 240, 164, AND 264. OF THE 822 CHILDREN, 103 HAD BEEN USING A SEAT BELT. CURRENT SEATBELT LEGISLATION IN SWEDEN EXEMPTS PERSONS UNDER THE AGE OF 15 AND/OR LESS THAN 150 CM IN HEIGHT FROM WEARING SEAT BELTS. IT HAS BEEN EXPRESSED AT VARIOUS TIMES THAT DUE TO THEIR WEAKER NECK MUSCLES, RELATIVE TO THE SIZE OF THE HEAD, CHILDREN ARE MORE SUSCEPTIBLE TO NECK INJURIES THAN ADULTS AND THAT BELTED CHILDREN WOULD RECEIVE SERIOUS INJURY TO THE NECK FROM THE BELT. FROM THE ANALYSIS OF THE ACCIDENT DATA, THERE IS NO INDICATION THAT BELTED CHILDREN ARE INJURED MORE OFTEN OR MORE SERIOUSLY THAN BELTED ADULTS; THAT BELTED CHILDREN SUSTAIN HEAD, CHEST, OR NECK INJURIES TO A GREATER EXTENT THAN BELTED ADULTS; AND THAT SHORT OCCUPANTS, INCLUDING CHILDREN, SHOULD SUSTAIN INJURIES TO THE NECK FROM THE BELT. ON THE OTHER HAND, THE ANALYSIS DOES INDICATE THAT OLDER CHILDREN (11 TO 14 AGE GROUP) USE THE SEAT BELT TO THE SAME EXTENT AS ADULTS AND THAT CHILDREN UNDER THE AGE OF 11 USE THE SEAT BELT SOMEWHAT LESS FREQUENTLY; AND THAT THE BELT HAS A PROTECTIVE/RESTRAINING EFFECT ON THE CHILDREN. APPENDED ARE CASE HISTORIES OF ACCIDENTS IN WHICH BELTED CHILDREN WERE INJURED.

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#### QUEENSLAND SURVEY ON INSTALLATION OF CHILD RESTRAINTS [AUSTRALIA]

A SURVEY WAS CONDUCTED TO INVESTIGATE WHETHER OR NOT CHILD RESTRAINT SYSTEMS WERE CORRECTLY FITTED TO A POPULATION OF VEHICLES IN BRISBANE (QUEENSLAND, AUSTRALIA). GENERALLY, THE FITTING OF CHILD RESTRAINTS TO VEHICLES ENTAILS THE LOCATION OF A SUITABLE ANCHORAGE POINT IN THE VEHICLE STRUCTURE, DRILLING A HOLE TO TAKE THE ANCHORAGE BOLT, AND CONNECTING THE CHILD RESTRAINT. FINALLY, IN THE CASE OF CHILD SAFETY SEATS, IT IS NECESSARY TO ADJUST THE WEBBING, THUS FIXING THE SEAT FIRMLY TO THE VEHICLE. THIS PROCEDURE HAS BEEN SIMPLIFIED TO A CERTAIN EXTENT FOLLOWING THE INTRODUCTION OF AUSTRALIAN DESIGN RULE 34 WHICH CAME INTO EFFECT ON 1 JUL 1976. IT ENSURES THAT ALL PASSENGER CARS MANUFACTURED ON OR AFTER THIS DATE HAVE INCORPORATED ONE CHILD RESTRAINT UPPER ANCHORAGE POINT FOR EACH REAR SEATING POSITION. THIS ANCHORAGE POINT

THE CURRENTLY APPROVED CHILDREN'S SAFETY SEATS. OTHER SEATS STILL REQUIRE ADDITIONAL FIXING POINTS AND ALL REQUIRE THE RESTRAINT ANCHORAGE STRAPS TO BE FIRMLY ADJUSTED. SEVENTY-TWO VEHICLES WERE FOUND TO HAVE AT LEAST ONE APPROVED CHILD RESTRAINT FITTED (A TOTAL OF 86 RESTRAINTS COMPRISING 75 CHILD SEATS AND 11 CHILD SAFETY HARNESSSES), AND 38 (ABOUT 44%) OF THESE RESTRAINTS WERE INCORRECTLY FITTED. THE MOST SERIOUS FAULT, THAT OF NOT HAVING ALL STRAPS CONNECTED TO THEIR RESPECTIVE ANCHORAGE POINTS, ACCOUNTED FOR 30.6% OF INCORRECTLY INSTALLED SEATS. OTHER MAJOR AREAS IN WHICH THE SEATS DEVIATED FROM THE RECOMMENDED FITTING PROCEDURE INCLUDED STRAP(S) NOT TIGHTENED (36.1%), ANCHORAGES POORLY LOCATED (27.7%), AND OTHER (5.6%). OF THE 11 CHILD SAFETY HARNESSSES INCLUDED IN THE SURVEY, TWO HAD THEIR UPPER ANCHORAGE POINT LOCATED IMMEDIATELY BEHIND THE VEHICLE CUSHION; NO OTHER FITTING FAULTS WERE RECORDED.

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#### BELTED OCCUPANTS IN FRONTAL CRASHES [UNITED KINGDOM]

THE COLLISION CIRCUMSTANCES UNDER WHICH BOTH FRONT-SEAT CAR OCCUPANTS WEARING SEAT BELTS RECEIVE INJURY IN THE BRITISH ENVIRONMENT ARE DISCUSSED, BASED ON DATA FROM SEVERAL DETAILED ENGINEERING AND MEDICAL RECONSTRUCTIONS OF COLLISIONS. THE PARTICULAR EXPERIENCE IN THE UNITED KINGDOM IS EMPHASIZED BECAUSE IT IS BELIEVED A MISTAKE TO THINK THAT THE CHARACTERISTICS OF CARS, OF COLLISIONS, AND PARTICULARLY OF BELT SYSTEMS, ARE UNIFORM WORLDWIDE. IN FRONTAL CRASHES THERE ARE TWO BASIC THEORETICAL LIMITS TO THE PROTECTION OF OCCUPANTS WEARING SEAT BELTS. AT THE LIMIT, EITHER THE SEAT BELT IS IMPOSING SUCH HIGH LOADS ON THE Wearer THAT SERIOUS INJURY RESULTS, OR ALTERNATIVELY, THE AVAILABLE RIDEDOWN DISTANCE IS REDUCED OR USED UP (FOR A VARIETY OF REASONS), AND INJURY-PRODUCING CONTACTS ARE MADE WITH THE CAR INTERIOR. FROM STUDYING THE BRITISH EXPERIENCE, IT IS FOUND THAT LIFE-THREATENING INJURIES FROM THE BELT ITSELF ARE NOT A FREQUENT OCCURRENCE NOW THAT LEGISLATION FOR ONE-HANDED OPERATION OF BELTS HAS RESULTED IN THE REPLACEMENT OF THE "Y" BELT WITH THE "V" TYPE IN MANY INSTALLATIONS. IN OLDER MODELS OF CARS WITH "Y" BELTS, THE INBOARD END COULD BE, AND OFTEN WAS, SO ADJUSTED THAT THE BUCKLE WAS ON THE

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ABDOMEN, AND THE LAP SECTION, UNDER LOAD, ROSE OFF THE ILIAC CRESTS AND CAUSED SERIOUS SOFT TISSUE DAMAGE TO THE ABDOMINAL CONTENTS. THE "V" TYPE BELT WITH A CENTER BOX FITTING FOR THE BUCKLE HAS VIRTUALLY ELIMINATED THIS MECHANISM OF INJURY, ALTHOUGH SOME OF THE CURRENT STALK SYSTEMS AND SYSTEMS WITH A COMMON POINT SEPARATED FROM THE BUCKLE STILL RESULT IN A POOR LAP BELT POSITION. IT IS ALSO EVIDENT THAT HEAD AND NECK INJURIES DO NOT OCCUR TO BELT WEARERS UNLESS THERE IS A HEAD CONTACT. THE DATA FURTHER SHOW THAT WITH A SEAT BELT, THE INTERNAL CONTENTS OF THE THORAX ARE NOT SERIOUSLY DAMAGED DUE TO DECELERATION ON THE BELT PER SE. IN GENERAL TERMS, FIELD EXPERIENCE FROM U.K. ACCIDENTS IS THAT THE LIMIT OF BELT PERFORMANCE IS NOT THE BELT ITSELF: INSTEAD, IT IS THE OCCURRENCE OF INTERIOR CONTACTS. THESE CONTACTS OCCUR EITHER BECAUSE THE COMPARTMENT IS CRUSHED (INTRUDED), OR BECAUSE THE BELT ALLOWS SO MUCH FORWARD MOVEMENT THAT THE OCCUPANT USES UP ALL THE AVAILABLE INTERIOR SPACE.

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1977; 5REFS  
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#### INVESTIGATION OF INJURY MECHANISMS IN FULLY RESTRAINED VEHICLE OCCUPANTS

A DATA COLLECTION METHODOLOGY WAS DEVELOPED AND DATA WERE COLLECTED AND ANALYZED AS PART OF A PROGRAM DESIGNED TO BETTER EVALUATE THE LIMITS OF PROTECTION OF THREE-POINT BELT RESTRAINT SYSTEMS. DATA CONSISTED OF INFORMATION ON INJURY MECHANISMS IN FULLY-RESTRAINED CAR OCCUPANTS. THE METHOD USED FOR COLLECTION AND RECORDING OF DATA PROVED EFFECTIVE AND FLEXIBLE IN PRACTICAL APPLICATION. NO INSTANCES WERE FOUND WHERE AN INJURY WAS MADE WORSE BY THE WEARING OF THE RESTRAINT SYSTEM. ANY INJURY ASSOCIATED DIRECTLY WITH THE BELT WAS CONFINED TO SUPERFICIAL BRUISING OR CRACKED RIBS, WITHOUT SERIOUS COMPLICATIONS. AT INJURY LEVELS ABOVE AIS (ABBREVIATED INJURY SCALE) 2, INTRUSION INTO THE OCCUPANT SPACE WAS THE MOST COMMON INJURY MECHANISM.

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TC-OSTS-0121  
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HS-023 280

#### FORENSIC PATHOLOGICAL AND BIOMECHANICAL EXPERIENCES AFTER THE FIRST YEAR OF MANDATORY BELT WEARING IN THE FEDERAL REPUBLIC OF GERMANY [SEAT BELTS]

THE EFFECT OF MANDATORY SEATBELT USAGE LEGISLATION IN THE FEDERAL REPUBLIC OF GERMANY (FRG), WHICH WENT INTO EFFECT ON 1 JAN 1976, ON TRAFFIC INJURIES/FATALITIES IS DISCUSSED, AS WELL AS LITERATURE ON THE EFFECTIVENESS OF SEAT BELTS IN PREVENTING INJURIES. IN THE FRG, 87% OF THE CARS ARE EQUIPPED WITH SAFETY BELTS, AND BELTS ARE USED IN NEARLY TWO THIRDS OF THE CARS IN WHICH THEY ARE INSTALLED. ABOUT 75% OF THE DRIVERS USE BELTS ON THE AUTOBAHN AND ON HIGHWAYS AND 54% IN TOWNS. TO DATE, EXPERIENCE IN BADEN-WURTTEMBERG INDICATES NO DECREASE IN THE NUMBER OF INJURED DRIVERS AS A RESULT OF THE LEGISLATION; HOWEVER, THERE HAS BEEN A DECREASE OF ABOUT 10% IN THE NUMBER OF PERSONS KILLED IN TRAFFIC ACCIDENTS (I.E. ALL VEHICLE OCCUPANTS AND PEDESTRIANS). IN THE FIRST YEAR FOLLOWING THE INTRODUCTION OF THE LEGISLATION, THE TOTAL NUMBER OF TRAFFIC DEATHS IN THE FRG DROPPED FROM 14,870 IN 1975 TO 14,560 IN 1976, A DECREASE OF LESS THAN 1.9%. HOWEVER, IT MUST BE REALIZED THAT ALTHOUGH THE DECREASE WAS RELATIVELY SMALL, A REDUCTION WAS ACHIEVED IN SPITE OF THE INCREASE IN THE NUMBER OF MOTOR VEHICLES (5.2%) AND TOTAL MILEAGE (4.7%). RESEARCH IS CITED WHICH SHOWS THE EFFECTIVENESS OF SEAT BELTS IN AFFORDING PROTECTION TO VEHICLE OCCUPANTS, THE SIGNIFICANCE OF AGE IN THE FREQUENCY AND SEVERITY OF INJURIES, AND THE HIGHER NUMBER OF NECK AND BACK INJURIES SUFFERED BY BELT USERS (ALTHOUGH SELDOM SEVERE). FURTHER DEVELOPMENT (BELT FORCE LIMITERS, PRELOADING, COMBINATIONS WITH THE AIR BAG, STANDARDIZED PARTS, AND PASSIVE SYSTEMS) OF CURRENTLY AVAILABLE RESTRAINT SYSTEMS, INFORMING AND INFLUENCING THE PUBLIC REGARDING THE PROTECTION OFFERED BY SEAT BELTS, INCENTIVES TO SEAT BELT USERS BY INSURANCE COMPANIES, AND INFORMING PHYSICIANS IF ACCIDENT VICTIMS HAVE WORN SAFETY BELTS, ARE ADVOCATED.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
THE INTERNATIONAL ASSOCIATION FOR ACCIDENT  
AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P365-91  
1977  
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INDUSTRIE E.V., WEST GERMANY.  
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**AN ANALYSIS OF 115 KILLED AND 205 SEVERELY INJURED (O AIS [ABBREVIATED INJURY SCALE] GREATER THAN OR EQUAL TO 2) SEAT BELT USERS [SWITZERLAND]**

INJURY PATTERNS OF 115 FATALITIES AND 205 CASES WITH INJURIES OF AIS (ABBREVIATED INJURY SCALE) 2 OR GREATER WHICH WERE THE RESULT OF TRAFFIC ACCIDENTS DURING THE FIRST NINE MONTHS OF 1976 IN SWITZERLAND, THE VICTIMS HAVING WORN SEAT BELTS, WERE ANALYZED. WITH RESPECT TO HEAD INJURIES, AIS 2 AND 3 WERE THE MOST PROMINENT (33%); MINOR CEREBRAL CONCUSSIONS, FACIAL BONE FRACTURES, AND EXTENSIVE SKIN LACERATIONS WERE COMMON. WITH INCREASING AIS (4, 5, AND 6), THE PERCENTAGE OF HEAD INJURIES WAS REDUCED (25%). ELEVEN OF THE 17 CERVICAL SPINE INJURIES (15 AIS 3, 2 AIS 2) OCCURRED IN CONNECTION WITH HEAD CONTACT OR INJURIES; IN ALL 12 CASES OF CERVICAL SPINE LESIONS RATED AIS 4, 5, OR 6, A HEAD CONTACT OR INJURY OCCURRED. A REMARKABLE FEATURE OF THE STUDY IN CONNECTION WITH "NECK INJURIES" IS THAT ONLY ONE CASE WAS OBSERVED WITH A SEVERE SKIN AND SOFT TISSUE LACERATION CAUSED BY A TWO-POINT SHOULDER BELT. THE THORACIC SPINE WAS INVOLVED ONLY IN ROLLOVER CRASHES (12 CASES), EXCEPT FOR TWO CASES OF FRONTAL COLLISIONS WHERE THE THORACIC-LUMBAR TRANSITION WAS AFFECTED. THE INJURIES CONSISTED GENERALLY OF COMPRESSION FRACTURES. ELEVEN AORTIC RUPTURES WERE FOUND, MAINLY LOCATED 1 OR 2 CM DISTAL TO THE LEFT SUBCLAVIAN JUNCTION. AIS 4, 5, AND 6 INJURIES WERE THE MOST COMMON IN THE ABDOMINAL REGIONS. IN 35 CASES (11%), THE BELT SYSTEM WAS DAMAGED DURING THE CRASH. IN 26 CASES (8%), THE BUCKLE OPERATION WAS INHIBITED EITHER DUE TO POOR ACCESSIBILITY OF THE BUCKLE FOR RESCUING PERSONS OR DUE TO JAMMED BUCKLES WHICH WERE NOT FUNCTIONAL AT ALL (TWO CASES) OR ONLY AFTER SEVERAL ATTEMPTS (TWO CASES). RELEASING PROBLEMS GENERALLY DID NOT LEAD TO AN INCREASE IN INJURY SEVERITY. NEVERTHELESS, AUTOMATIC RELEASING SYSTEMS AND SPECIAL BELT KNIVES COULD BE HELPFUL. "TYPICAL" BELT INJURIES OR LACK OF THEM AND DAMAGE TO THE SEATBELT SYSTEM ARE NOT APPLICABLE AS CRITERIA FOR DETERMINING SEATBELT USAGE OF OCCUPANTS.

by FELIX WALZ; PETER NIEDERER; UELI ZOLLINGER; ADRIAN RENFER  
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1977

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HSL 78-11

HS-023 282

**THE EFFECT OF SEAT BELT DESIGN AND ANCHORAGE GEOMETRY ON INJURY PATTERNS [AUSTRALIA]**

THE EFFECT OF SEATBELT DESIGN AND ANCHORAGE GEOMETRY ON INJURY PATTERNS HAS BEEN EXAMINED AS PART OF A PROGRAM OF FIELD (AUSTRALIA) AND LABORATORY INVESTIGATIONS. INJURY INDUCED BY THE BELT ITSELF IS RARE. IT IS MOST COMMONLY SUFFERED IN THE ABDOMINAL REGION BY ELDERLY OCCUPANTS. FACTORS PREDISPOSING TO SUCH INJURY INCLUDE SLACKNESS OF ADJUSTMENT AND THE GEOMETRY OF THE INSTALLATION OF THE LAP PORTION OF THE SEAT BELT, INCLUDING ITS ANGLE FROM THE HORIZONTAL. RADIOGRAPHIC AND OTHER ANATOMICAL STUDIES HAVE SHOWN THAT THE PERMITTED MINIMUM ANGLE OF APPROACH OF THE LAP BELT SHOULD BE SUBSTANTIALLY INCREASED FROM THE PRESENT FIGURE OF 25° FROM THE HORIZONTAL, AND THAT MOUNTING THE LAP PORTION ON THE SEAT WOULD BE ADVANTAGEOUS. HEAD AND NECK INJURIES IN THE ABSENCE OF HEAD CONTACT ARE EXCEEDINGLY RARE. THE SASH PORTION OF THE LAP-SASH BELT IS RARELY THE SOURCE OF SEVERE INJURY. SEAT BELTS PERMIT SOME EXCURSION OF THE BODY IN CRASHES, AND THIS EXCURSION IS A COMMON CAUSE OF INJURY AMONG BELTED OCCUPANTS. LATERAL EXCURSION OCCURS IN CRASHES ONLY A FEW DEGREES AWAY FROM HEAD-ON; AND HEAD CONTACT, THE COMMONEST CAUSE OF DEATH AMONG SEAT-BELTED OCCUPANTS, COMMONLY OCCURS AGAINST PARTS OF THE VEHICLE NOT COVERED BY AUSTRALIAN DESIGN RULES. EMERGENCY LOCKING RETRACTORS INCREASE EXCURSION, BUT NOT TO A DANGEROUS EXTENT; AND EXCURSION COULD BE MINIMIZED BY THE USE OF PRE-TENSIONING DEVICES. RETRACTORS MANDATED BY AUSTRALIAN DESIGN RULES APPEAR TO WORK WELL IN THE FIELD. FINALLY, BELTED OCCUPANTS ARE MOST COMMONLY INJURED BY FACTORS NOT DIRECTLY RELATED TO SEATBELT DESIGN AND ANCHORAGE GEOMETRY, SUCH AS RIGIDITY OF CAR SIDE INTERIORS, INTRUSION OF THE CAR'S INTERIOR SURFACE, AND INTRUSION OF EXTRANEOUS OBJECTS.

by J. MICHAEL HENDERSON; BRIAN A. VAZEY; DAVID C. HERBERT; JOHN D. STOTT  
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1977; 7REFS

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HS-023 283

**INJURY PATTERNS WITH AND WITHOUT SEAT BELTS [AUSTRALIA]**

A DETAILED ANALYSIS IS PRESENTED OF INJURY AND CRASH DATA FROM THE FIRST TWO YEARS OF

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THE ROYAL AUSTRALASIAN COLLEGE OF SURGEON'S PATTERN OF INJURY SURVEY OF ROAD CASUALTIES IN VICTORIA, AUSTRALIA WHICH COMMENCED IN JUN 1971 AND WHICH REPRESENTS THE FIRST LARGE-SCALE COLLECTION OF SUCH DATA ANYWHERE IN AUSTRALIA FOLLOWING ENACTMENT OF COMPULSORY SEATBELT USAGE LEGISLATION. AN ANALYSIS OF 387 FATALLY INJURED OCCUPANTS OF CARS AND CAR DERIVATIVES SHOWED THE MORE COMMON INJURIES TO BE FRACTURES OF THE SKULL, FACIAL BONES, CHEST AND THIGH, AND HEMOTHORAX, AND DAMAGE TO THE BRAIN, LUNGS, AORTA, SPLEEN, AND LIVER. THE INJURY PATTERNS OF 6526 ACCIDENT SURVIVORS WERE ALSO ANALYZED. WHILE THE INJURIES COMMONLY ASSOCIATED WITH FATALITIES WERE MUCH LESS COMMON AMONG THE SURVIVING CASUALTIES, ALL EXCEPT SPLEEN DAMAGE WERE FOUND TO BE SIGNIFICANTLY MORE LIKELY TO HAVE BEEN SUSTAINED BY OCCUPANTS NOT WEARING SEAT BELTS. WHIPLASH INJURY AND TRANSIENT CERVICAL SPINAL CORD DAMAGE, WHICH WERE APPARENTLY NOT COMMON AMONG FATALITIES, WERE FOUND TO OCCUR SIGNIFICANTLY MORE OFTEN TO SEATBELT WEARERS. NONEJECTED FRONT OUTBOARD SEAT OCCUPANT CASUALTIES HAD SIMILAR DIFFERENCES IN INJURY PATTERNS AS DID ALL OCCUPANT CASUALTIES, WHEN BELTED AND UNRESTRAINED CASUALTIES WERE COMPARED. ONE EXCEPTION WAS THAT BELTED CASUALTIES WERE LESS LIKELY TO HAVE SUSTAINED LEFT KIDNEY DAMAGE THAN UNRESTRAINED CASUALTIES. FOR BELTED VS. UNBELTED NONEJECTED FRONT OUTBOARD SEAT OCCUPANT CASUALTIES, THERE WERE CRITICAL DIFFERENCES IN VEHICLE SIZE, IMPACT DIRECTION, AND OCCUPANT AGE AND SEX, EACH OF WHICH COULD HAVE AFFECTION CRASH SEVERITY (AS EXPERIENCED BY THE OCCUPANT) OR INJURY SUSCEPTIBILITY. THE ABSENCE OF CRASH SEVERITY INFORMATION PREVENTED A DEFINITIVE EVALUATION OF THE EFFECT OF SEAT BELTS ALONE ON THE INJURY PATTERNS. THREE SEVERE INJURIES WERE MORE LIKELY TO HAVE BEEN SUSTAINED BY NONEJECTED, FRONT OUTBOARD SEAT OCCUPANTS WHEN SEAT BELTS WERE WORN UNDER CERTAIN CIRCUMSTANCES. THESE INJURIES WERE FRACTURED THIGHS IN HEAD-ON IMPACTS, AND DAMAGED LIVERS AND SPLEENS SUSTAINED BY OCCUPANTS AGED 50 AND OVER.

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AUSTRALIA  
Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
THE INTERNATIONAL ASSOCIATION FOR ACCIDENT  
AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P423-79  
1977; 2REFS  
SPONSORED BY COMMONWEALTH DEPT. OF  
TRANSPORT (AUSTRALIA).  
Availability: IN HS-023 250

HS-023 284

#### ALLEVIATION OF INJURIES BY USE OF SEAT BELTS [ENGLAND]

TO ASSESS THE EFFECTIVENESS OF SEAT BELTS IN TERMS OF RISKS OF INJURY RELATED TO SEVERITY, LOCATION, AND NATURE OF INJURY, AN IN-DEPTH STUDY WAS MADE OF A REPRESENTATIVE SAMPLE OF INJURIES TO VEHICLE OCCUPANTS IN 1126 TRAFFIC ACCIDENTS IN ENGLAND DURING 1974-1976. WHERE SEAT BELTS WERE WORN A COMPARISON WAS MADE BETWEEN THE LEVELS OF INJURIES RECEIVED AND THOSE THAT WOULD HAVE BEEN EXPECTED IF BELTS HAD NOT BEEN WORN. THE USE OF SEAT BELTS RESULTED IN A STATISTICALLY SIGNIFICANT REDUCTION IN LIFE-THREATENING INJURIES (AIS (ABBREVIATED INJURY SCALE) 6) OF 86% FROM THE EXPECTED LEVEL. SIGNIFICANT REDUCTIONS ALSO OCCURRED IN THE LESS SEVERE CATEGORIES OF INJURY, BUT THESE APPEAR SMALLER DUE TO THE GENERAL DOWNWARD SHIFT IN INJURY SEVERITY ASSOCIATED WITH SEAT BELT WEARING. OF THE BELTED OCCUPANTS, 42% ESCAPED INJURY ALTOGETHER COMPARED TO 28% OF THE UNBELTED PERSONS. AT THE LEVELS OF INJURY WHERE THERE WERE SIGNIFICANT REDUCTIONS AMONG BELT WEARERS, I.E. AIS 2 AND ABOVE, THERE WAS A LOWER INCIDENCE OF INJURY FOR ALL REGIONS OF THE BODY EXCEPT THE NECK AND FEET. ALTHOUGH NECK INJURIES WERE SLIGHTLY MORE NUMEROUS AMONG BELTED OCCUPANTS, ALL WERE OF EITHER MINOR OR MODERATE (AIS 1-2) SEVERITY. NO FRACTURES OF THE NECK OCCURRED. THE HEAD WAS FOUND TO BE THE MOST COMMONLY INJURED REGION OF THE BODY, USUALLY CAUSED BY CONTACT WITH THE STEERING WHEEL OR THE AREA SURROUNDING THE WINDSHIELD FOR UNBELTED OCCUPANTS AND THE STEERING WHEEL FOR THOSE BELTED. FOR MOST OTHER REGIONS OF THE BODY, CONTACT WITH THE SIDE OF THE PASSENGER COMPARTMENT WAS THE MAIN CAUSE OF INJURY. ALTHOUGH SOME INJURIES WERE DUE TO DIRECT SEATBELT LOADING, MOST OF THESE WERE OF MINOR SEVERITY. SEAT BELTS OFFERED PROTECTION BY PREVENTING EJECTION OF THE WEARER FROM THE VEHICLE. THE TYPE OF BELT IN USE WAS KNOWN IN THE CASE OF JUST OVER HALF OF THE WEARERS. A COMPARISON BETWEEN STATIC AND AUTOMATIC LAP AND DIAGONAL BELTS DID NOT REVEAL ANY SIGNIFICANT DIFFERENCE IN THEIR ABILITY TO PREVENT OR REDUCE INJURY. HOWEVER, IT IS IMPORTANT TO NOTE THAT THERE WAS A HIGHER WEARING RATE (38%) FOR AUTOMATIC BELTS VS. STATIC BELTS (26%).

by BARBARA E. SABEY; B. E. GRANT; C. A. HOBBS  
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RD., CROWTHORNE, BERKS., ENGLAND  
Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF  
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AND TRAFFIC MEDICINE (6TH) PROCEEDINGS,"  
MELBOURNE, 1977 P480-4  
1977; 1REF  
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#### MEDICAL EXEMPTIONS FROM SEAT-BELT REQUIREMENTS

MEDICAL EXEMPTIONS FROM THE REQUIREMENTS OF THE SWEDISH MANDATORY SEATBELT USE LAW ARE DISCUSSED. THE SWEDISH NATIONAL BOARD OF HEALTH AND WELFARE FIRST ISSUED RULES FOR MEDICAL EXEMPTIONS FROM THE LAW WHICH COVERED PHYSICALLY HANDICAPPED PERSONS WHO WOULD EXPERIENCE MAJOR DIFFICULTY IN FASTENING OR LOOSENING THE BELT OR FOR WHOM THE USE OF THE SEAT BELT, IN CONJUNCTION WITH THE PHYSICAL HANDICAP, WOULD MARKEDLY INCREASE THE DIFFICULTY OF OPERATING A MOTOR VEHICLE. DURING THE FIRST FEW MONTHS THE LEGISLATION WAS IN EFFECT, JAN TO JUN 1975, SOMEWHAT OVER 1000 CERTIFICATES OF MEDICAL EXEMPTION WERE ISSUED BY LICENSED PHYSICIANS. SINCE JUL 1975 A NEW REGULATION ON MEDICAL EXEMPTIONS FROM SEATBELT USE HAS BEEN IN FORCE. THIS REGULATION AUTHORIZES EXEMPTIONS BASED ON PSYCHIATRIC AS WELL AS PHYSICAL GROUNDS. PSYCHIATRIC EXEMPTIONS CAN BE GRANTED WHEN THE DEGREE OF MENTAL DISTURBANCE IS SO MARKED THAT THE SEAT BELT IS DEEMED UNUSABLE. EXEMPTIONS FOR MENTAL REASONS CAN BE CERTIFIED ONLY BY PHYSICIANS WITH EXPERTISE IN PSYCHIATRIC DISORDERS (GENERAL PSYCHIATRY, CHILD AND ADOLESCENT PSYCHIATRY, CRIMINAL PSYCHIATRY) OR WHO OCCUPY POSITIONS AS SENIOR PHYSICIANS OR DEPUTY SENIOR PHYSICIANS WITHIN THE AFOREMENTIONED FIELDS. CERTIFICATES OF EXEMPTION ARE TO BE CARRIED DURING CAR TRAVEL AND SHOWN TO THE POLICE ON DEMAND. FROM JUL 1975 TO SEP 1976, 189 CERTIFICATES WERE ISSUED, 146 FOR PHYSICAL REASONS, 30 FOR PSYCHIATRIC REASONS, AND 5 FOR COMBINED REASONS. EIGHT CASES WERE NOT FOLLOWED THROUGH. (SWEDEN'S POPULATION IS APPROXIMATELY 8 MILLION, AND THE NUMBER OF PASSENGER CARS REGISTERED IS ABOUT 2.5 MILLION.) THE MOST COMMON REASON FOR PSYCHIATRIC EXEMPTION IS CLAUSTROPHOBIA. EXPERIENCE HAS SHOWN, HOWEVER, THAT IN MANY CASES A MENTALLY DISTURBED PERSON CAN BE PERSUADED TO USE A SEAT BELT IF GIVEN SUITABLE INFORMATION. MOST COMMON PHYSICAL REASONS FOR EXEMPTION ARE IMPAIRED MOBILITY DUE TO STIFFNESS OF BACK OR NECK, HIP ARTHRITIS, RHEUMATOID ARTHRITIS, OBESITY, COLOSTOMY, THORACOPLASTY, AND MULTIPLE SCLEROSIS. IN SOME CASES, PERSONS WEARING PACEMAKERS HAVE BEEN EXEMPTED.

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#### THE INFLUENCE OF SEAT BELT WEARING ON THE INCIDENCE OF SEVERE HEAD INJURY [AUSTRALIA]

RECORDS OF PATIENTS WITH A DIAGNOSIS OF HEAD INJURY, CONCUSSION, FRACTURED SKULL, OR FACIAL INJURY ADMITTED TO PRINCE HENRY'S HOSPITAL, MELBOURNE, AUSTRALIA DURING PERIODS PRIOR TO AND AFTER THE ENACTMENT OF MANDATORY SEATBELT USAGE LEGISLATION WERE ANALYZED. THE LEGISLATION WENT INTO EFFECT ON 1 JAN 1971, AND PATIENTS' RECORDS WERE STUDIED FOR THE 12-MONTH PERIOD PRIOR TO THE LAW, THE 12-MONTH PERIOD STARTING 18 MONTHS AFTER THE LAW WAS FIRST INTRODUCED (1972-1973), AND FOR THE YEAR 1976. HEAD INJURIES HAVE BEEN CLASSIFIED INTO MILD OR SEVERE ON THE BASIS OF THE PATIENT'S RECORDED CONSCIOUS STATE AND MENTAL STATE AT THE END OF ONE WEEK OR SOONER. IF A PATIENT WERE CLEARLY CONSCIOUS AND MENTALLY NORMAL AT THE END OF THAT TIME, THE INJURY WAS CLASSIFIED AS MILD. IF THERE WERE ANY IMPAIRMENT OF THESE FUNCTIONS AT THE END OF THAT TIME, THE INJURY WAS CLASSIFIED AS SEVERE. THE FOLLOWING HEAD INJURY DATA FOR VEHICLE OCCUPANTS WERE COMPILED: 37 MILD AND 33 SEVERE HEAD INJURIES (1969-1970); 74 MILD AND 12 SEVERE HEAD INJURIES (1972-1973); AND 25 MILD AND 7 SEVERE HEAD INJURIES (1976). WITH RESPECT TO OTHER CASES OF HEAD INJURIES TREATED AT THE HOSPITAL, PEDESTRIANS HIT BY CAR OR MOTORCYCLE EXPERIENCED A SIGNIFICANT INCIDENCE OF SEVERE HEAD INJURY. THE MAIN FACTOR IN THE REDUCTION OF THE INCIDENCE OF SEVERE HEAD INJURY AMONG VEHICLE OCCUPANTS HAS BEEN THE STEADILY INCREASING USE OF SEAT BELTS, ALTHOUGH THE IMPOSITION OF A MAXIMUM SPEED LIMIT (60 MPH, CHRISTMAS EVE 1973) MAY ALSO BE A FACTOR.

by PETER G. PETTY  
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1977

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#### PATTERN OF ROAD TRAFFIC ACCIDENTS IN THE STATE OF QATAR

THE STATE OF QATAR (ARABIAN GULF) HAS AN ESTIMATED POPULATION OF 200,000 PEOPLE MOST OF WHOM ARE CONCENTRATED AROUND THE CAPITAL OF DOHA. THERE ARE PRESENTLY 60,000 REGISTERED VEHICLES IN THE COUNTRY, WITH AN EFFECTIVE INCREASE OF 20,000-25,000 VEHICLES/YEAR. THE USE OF SEAT BELTS AND HEAD RESTS FOR CAR OCCUPANTS AND CRASH HELMETS FOR MOTORCYCLISTS IS NOT MANDATORY. EVEN IF SUCH PROTECTIVE DEVICES ARE AVAILABLE TO

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THE MOTORIST, THEY ARE SELDOM USED. THE STATISTICS FOR ACCIDENT CASUALTIES BROUGHT TO THE ONE MAJOR HOSPITAL REFLECT THE SERIOUSNESS OF THE TRAFFIC SAFETY PROBLEM IN THE COUNTRY. FOR 1975, 333 TRAFFIC CASUALTIES WERE ADMITTED TO THE HOSPITAL AND IN 1976, 520 TRAFFIC CASUALTIES WERE ADMITTED. IN 1975 THERE WERE A TOTAL OF 683 TRAFFIC ACCIDENTS COMPARED TO 1290 IN 1976. THE AGE DISTRIBUTION OF CASUALTIES PEAKS AT THE 21-30 AGE GROUP, FOLLOWED BY THE 31-40 AGE GROUP. A DISTURBING FACT IS THE LARGE NUMBER OF CHILDREN UNDER 10 YEARS OF AGE INVOLVED IN TRAFFIC ACCIDENTS. WEALTH, RECENT MOTORIZATION, AMBITIOUS PEOPLE, INADEQUATE ROADS, INADEQUATE PROTECTION OF ROAD USERS, LACK OF LEGISLATION, FONDNESS FOR SPEEDING, INADEQUATE ROAD AND TRAFFIC SENSE, ETC., APPEAR TO CONTRIBUTE DIRECTLY OR INDIRECTLY TO THE ALARMINGLY INCREASING RATE OF SERIOUS TRAFFIC ACCIDENTS IN THE COUNTRY.

by N. S. BHAT; ABDULLA A. R. AL-BAKER; THOMAS GEORGE  
DOHA GENERAL HOSP., DOHA, QATAR  
Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P494-500  
1977  
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HS-023 288

#### TRAUMATIC RUPTURE OF THE AORTA IN ROAD CRASH VICTIMS [AUSTRALIA]

IN AN INVESTIGATION OF 1970-1972 TRAFFIC ACCIDENTS, 15% OF A SERIES OF 500 CAR OCCUPANTS KILLED HAD RUPTURED AORTAS. IN ANOTHER SERIES, 9% OF 470 PEDESTRIANS KILLED BETWEEN 1958 AND 1972 HAD RUPTURED AORTAS. A MOST RECENT STUDY OF ROAD DEATHS IN THE MELBOURNE (AUSTRALIA) METROPOLITAN AREA DURING 1974-1976 SHOWED THAT OF 1336 ROAD DEATHS, 14.8% HAD RUPTURED AORTAS. IT IS GENERALLY CONSIDERED THAT THE SITE OF RUPTURE OCCURS IN THE REGION OF THE AORTIC Isthmus. THE FREQUENCY AND SITE OF TEAR ARE AS FOLLOWS: 79%, JUST LATERAL TO LIGAMENTUM ARTERIOSUM; 19%, JUST ABOVE AORTIC VALVES; 1%, LUMBAR AORTA; AND 1%, MULTIPLE TEARS. THE AGE DISTRIBUTION FOR VICTIMS PEAKS AT 20-30 YEARS OF AGE. THE AORTIC TEARS ARE ALMOST ALWAYS CIRCUMFERNENTIAL. IN THE 1974-1976 SERIES OF TRAFFIC FATALITIES, COMPLETE CIRCUMFERNENTIAL TEARS OCCURRED AS FOLLOWS: 69% OF DRIVERS, 67% OF PASSENGERS, 81.7% OF PEDESTRIANS, AND 63.5% OF CYCLISTS. THERE WERE NO FLEXION FRACTURES OF THE DORSAL SPINE ASSOCIATED WITH AORTIC RUPTURE. THE POSSIBILITY OF FORCIBLE HYPEREXTENSION OF THE DORSAL SPINE AND TRACTION BY THE RECURRENT LARYNGEAL NERVE MAY BE A MAJOR CONTRIBUTORY FACTOR. IF SUCH IS THE CASE, A SATISFACTORY RESTRAINING HAR-

NESS WOULD BE A PROTECTIVE MEASURE AGAINST SUCH INJURY.

by DONALD W. HOSSACK

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HS-023 289

#### PSYCHOLOGICAL PROBLEMS OF RESTRAINT SYSTEMS SUCH AS THE SEAT BELTS AND THE AIR BAGS IN WEST GERMANY

VARIOUS RESEARCH HAS SHOWN THAT THE ACCEPTANCE OF OR RESISTANCE TO USING SEAT BELTS DEPENDS ON BASIC PATTERNS OF DRIVING: ONE PATTERN TENDS TO PLEASURE FULFILLMENT, THE OTHER TO A GUARDED ATTITUDE TO TRAFFIC. IT CAN BE EXPECTED THAT AS LONG AS DRIVERS SEEK MAXIMUM PLEASURE FROM DRIVING, THE SAFETY BELT HAS ONLY LIMITED CHANCES OF BEING ACCEPTED. IT IS PART OF THE UNFAVORABLE PSYCHOLOGY OF SEAT BELTS THAT EVERY ACT OF FASTENING EVOKES A FEAR OF BEING TRAPPED IN A CLOSED CAGE. THROUGH SUCH FEARS DRIVERS QUICKLY RESORT TO EXCUSES FOR AVOIDING WHAT FOR THEM IS AN UNPLEASANT SYSTEM. ON THE OTHER HAND, THOSE DRIVERS WITH A GUARDED ATTITUDE TOWARD DRIVING SIGNIFICANTLY MORE INSURANCE CONTRACTS, CARRY MORE TOOLS FOR USE IN AN EMERGENCY, AND INSTALL MORE SAFETY DEVICES IN THEIR CARS. IT HAS BEEN PROVEN THAT DRIVERS WITH STRONG PLEASURE FULFILLMENT TENDENCIES ARE MOST IN FAVOR OF THE AIR BAG. THE GUARDED DRIVERS, ON THE OTHER HAND, PREFER THE SAFETYBELT SYSTEM; EVIDENTLY THEY LIKE TO TAKE RESPONSIBILITY FOR THEIR SAFETY INTO THEIR OWN HANDS. IT IS OF THE UTMOST IMPORTANCE THAT ANY INTRODUCTION OF A RESTRAINT SYSTEM SHOULD TAKE INTO ACCOUNT THESE DIFFERENT PATTERNS OF COPING WITH FEARS AND DANGERS IN TRAFFIC. THERE HAS BEEN A DOWNWARD TREND IN SEATBELT USAGE IN WEST GERMANY SINCE THE INTRODUCTION OF MANDATORY SEATBELT USAGE LEGISLATION ON 1 JAN 1976. IT SEEMS THAT THE SEATBELT SYSTEM AND ITS MANDATORY USE HAVE DEMANDED TOO MUCH OF THE DRIVERS. IT IS FELT MORE REALISTIC TO INTRODUCE THE AIRBAG SYSTEM ON A MUCH WIDER SCALE.

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Availability: IN HS-023 250

## LEGISLATION

TO EVALUATE THE EFFECT OF SWEDEN'S MANDATORY SEATBELT USAGE LEGISLATION WHICH WENT INTO EFFECT ON 1 JAN 1975, FATAL TRAFFIC ACCIDENTS INVOLVING PASSENGER CARS OCCURRING IN THE COUNTRY IN 1975 WERE ANALYZED. INFORMATION WAS OBTAINED FOR 458 OUT OF A TOTAL OF 469 SUCH ACCIDENTS. THERE WAS AN INVOLVEMENT OF 1366 PERSONS IN THESE ACCIDENTS, AND BY DEC 1976, 560 OF THEM HAD DIED. IN SINGLE-VEHICLE ACCIDENTS 228 PERSONS WERE KILLED (179 DRIVERS, 55 FRONT-SEAT PASSENGERS, 34 REAR-SEAT PASSENGERS). IN MULTIPLE VEHICLE ACCIDENTS 332 PERSONS WERE KILLED (189 DRIVERS, 82 FRONT-SEAT PASSENGERS, 61 REAR-SEAT PASSENGERS). OF THE FATALLY INJURED PERSONS IN SINGLE ACCIDENTS, 52 WORE BELTS. IN COLLISIONS 155 PERSONS WORE BELTS. THE MEAN AVERAGE USE OF BELTS IN SWEDEN DURING 1975 FOR DRIVERS AND FRONT-SEAT PASSENGERS (REQUIRED BY LAW TO WEAR BELTS) WAS NOT LESS THAN 82%-85%. THERE IS NO EVIDENCE THAT THE WEATHER, THE GEOMETRY OF THE ROAD, OR THE CONDITION OF THE CAR ARE SIGNIFICANT FACTORS IN ACCIDENT CAUSATION. HUMAN FACTORS SEEM TO HAVE THE GREATEST IMPORTANCE. IN SINGLE ACCIDENTS, ALCOHOL SEEMS TO BE THE MOST IMPORTANT CAUSAL FACTOR: OF 123 FATALLY INJURED DRIVERS IN SINGLE ACCIDENTS, 62 WERE UNDER THE INFLUENCE OF ALCOHOL, AND OF 175 INVESTIGATED FATALLY-INJURED DRIVERS INVOLVED IN COLLISIONS, 20 WERE UNDER THE INFLUENCE OF ALCOHOL. ALSO, INVESTIGATION OF 200 FATALLY INJURED OR SURVIVING DRIVERS INVOLVED IN SINGLE ACCIDENTS SHOWED THAT 50% HAD CRIMINAL AND/OR SOCIAL RECORDS AND/OR WERE UNDER THE INFLUENCE OF ALCOHOL. IT IS PERHAPS NOT SURPRISING THAT THE BELT-WEARING FREQUENCY OF PERSONS WITH SOCIAL PROBLEMS WAS VERY LOW.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P512-22

1977

Availability: IN HS-023 250

HS-023 291

## RESTRAINT SYSTEM EFFECTIVENESS IN THE U.S.A. MEASUREMENT OF THE PRESENT AND PREDICTION OF THE FUTURE

A FIELD EVALUATION PROGRAM WAS UNDERTAKEN TO COMPARE THE RESTRAINT SYSTEM USED IN U.S. 1973 MODEL YEAR AUTOMOBILES AND THAT USED IN 1974 MODEL YEAR CARS. THE 1974 CARS HAD AN IGNITION INTERLOCK WHICH WAS INTENDED TO INHIBIT THE OPERATOR FROM STARTING THE CAR

RESTRAINTS OF THE 1973'S. IT WAS ANTICIPATED THAT THE WEAR RATE IN THE 1974'S WOULD BE APPRECIABLY HIGHER, AND THAT AS A RESULT OF BOTH THIS AND THE INCREASE IN THE "FULL RESTRAINT" WEARING OCCASIONED BY THE THREE-POINT BELTS, INJURIES TO OCCUPANTS OF THE 1974 CARS WOULD BE LESSENED. USAGE OF THE FULL RESTRAINT SYSTEM IN THE 1974 CARS (THE ONES WITH THE PERMANENTLY JOINED UPPER AND LOWER BELTS) WAS EIGHT TO TEN TIMES GREATER THAN IN THE 1973'S. FULL RESTRAINT USAGE IN THE 1974 MODELS RANGED FROM 33% IN NEW YORK TO 39% IN MICHIGAN TO 45% IN TEXAS. WITH RESPECT TO A DECREASE IN THE PROBABILITY OF AN INJURY OF AIS (ABBREVIATED INJURY SCALE) 2 OR GREATER FOR THE 1974 OCCUPANT AS COMPARED WITH A 1973 OCCUPANT, FOR NEW YORK DATA THE 1974 OCCUPANT WAS 1% WORSE OFF, FOR MICHIGAN DATA THE 1974 OCCUPANT WAS 4% WORSE OFF, AND FOR TEXAS DATA THE 1974 OCCUPANT WAS 21% BETTER OFF. WHILE THE ORIGINAL PURPOSE OF THE EXPERIMENT WAS TO STUDY THE DIFFERENCES BETWEEN THE TWO MODEL YEARS, BEST ESTIMATES OF BELT WEARING WERE OBTAINED IN THE INVESTIGATION. LAP BELTS (IN THIS POPULATION) HAVE REDUCED THE INCIDENCE OF SEVERE INJURY FROM 47% TO 54%; LAP AND UPPER TORSO RESTRAINTS HAVE PROVIDED MORE PROTECTION, 41% TO 64%; BUT THE MARGINAL BENEFIT OF THE FULL RESTRAINT OVER LAP BELTS IS NOT AS GREAT AS FOR THE LAP BELTS OVER NO RESTRAINT. THE ADDITIONAL BENEFITS OF THE FULL RESTRAINT, EVEN WHEN COMBINED WITH THEIR INCREASED USE IN 1974 CARS, WERE NOT GREAT ENOUGH COMPARED TO LAP BELTS TO SUBSTANTIALLY AND CONSISTENTLY REDUCE THE INCIDENCE OF SEVERE INJURY IN 1974 CARS. FOR THE 1973-1974 MODEL YEAR COMPARISON, THERE WAS ESSENTIALLY NO DIFFERENCE IN INJURY RATE, AND IT WAS CONCLUDED THAT THE 1973 RESTRAINT SYSTEM (WITH ABOUT 30% OF THE OCCUPANTS WEARING LAP BELTS ONLY AND 4% WEARING A FULL SYSTEM) WAS AS GOOD AS THE 1974 SYSTEM WITH A SLIGHTLY HIGHER WEAR RATE.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P523-8  
1977  
Availability: IN HS-023 250

HS-023 292

## FUTURE DIRECTIONS FOR VEHICLE OCCUPANT PROTECTIONS: COMPLEX PROBLEMS REQUIRE MULTIFACETED [SIC], SYSTEMATIC SOLUTIONS

DEPARTMENT OF TRANSPORTATION SECRETARY COLEMAN'S ANNOUNCEMENT OF DEC 1976 IS OUTLINED. WHILE CALLING FOR A TRIAL OF PASSIVE

November 30, 1978

HS-803 066

RESTRAINT SYSTEMS IN HALF A MILLION 1978-1979 MODEL YEAR CARS, THE SECRETARY ALSO DIRECTED THE ISSUANCE OF IMPROVED COMFORT AND CONVENIENCE STANDARDS FOR SEAT BELTS, AND THE INITIATION OF A NATIONAL PUBLIC EDUCATION CAMPAIGN ON SEATBELT USE. WHILE THIS PROGRAM MAY SATISFY NEITHER THE PASSIVE OR ACTIVE RESTRAINT SYSTEM PARTISANS, IT REFLECTS THE BASIC FACT THAT THERE IS GENERAL AGREEMENT THAT BOTH SYSTEMS HAVE SIGNIFICANT POTENTIAL FOR REDUCING HIGHWAY CASUALTIES, PARTICULARLY IN COUNTRIES WITH LOW SEATBELT USAGE RATES SUCH AS THE U.S. THE STUDY PROPOSAL FOR PASSIVE RESTRAINT SYSTEMS CALLS FOR AUTO MANUFACTURERS TO PROVIDE HALF A MILLION CARS WITH PASSIVE RESTRAINT SYSTEMS AT A COST OF \$100 EACH TO THE PUBLIC IN 1978 AND 1979 CARS. INSURANCE COMPANIES WILL ALSO BE ASKED TO COOPERATE BY REDUCING THE PREMIUMS OF THOSE WHO PURCHASE THESE SYSTEMS. IN PARALLEL WITH THIS DEVELOPMENT PROGRAM, THE EFFORT TO INCREASE SEATBELT UTILIZATION WILL BE INCREASED. THIS EFFORT FALLS INTO TWO ENGINEERING AND TWO DRIVER PROGRAM AREAS. SAFETYBELT ENGINEERING PROGRAMS CALL FOR IMPROVEMENT IN THE COMFORT AND CONVENIENCE OF SEATBELT SYSTEMS AND IN "WARNING" SYSTEMS DESIGNED TO INCREASE BELT USE. IN THE DRIVER PROGRAM AREA, A NATION-WIDE EDUCATIONAL EFFORT IS BEING FUNDED TO IMPROVE THE GENERAL LEVEL OF ACCEPTANCE OF SAFETYBELT SYSTEMS, AND SPECIFIC DEMONSTRATION PROJECT EFFORTS ARE BEING PLANNED FOR THE STATES MOST LIKELY TO BE CANDIDATES FOR COMPULSORY SEATBELT USAGE LEGISLATION.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P529-33  
1977; 8REFS  
Availability: IN HS-023 250

HS-023 293

#### TRENDS IN OCCUPANT PROTECTION AND CRASH PERFORMANCE IN EUROPE

MOST OF THE CURRENT EUROPEAN SAFETY REQUIREMENTS ARE ESSENTIALLY DESIGN RULES; UNFORTUNATELY, SUCH A PROCEDURE DOES NOT RESULT IN OPTIMAL CRASH PERFORMANCE. DESIGN RULES MIGHT BE ACCEPTABLE IF ALL VEHICLES HAD THE SAME MASS, THE SAME GEOMETRY, AND THE SAME DYNAMIC STIFFNESS REQUIREMENTS; BUT IN REALITY THIS IS NOT THE CASE. THEREFORE, IN AN ATTEMPT TO SOLVE THE INADEQUACY OF THE PRESENT EUROPEAN SYSTEM, CRASH PERFORMANCE LEGISLATION IS BEGINNING TO GO THROUGH A TRANSITION PERIOD, PASSING FROM THE DESIGN RULE ERA AIMING TOWARDS PERFORMANCE STANDARDS. THE ULTIMATE IN A PERFORMANCE STANDARD IS EMBODIED IN THE PROPOSED U.S. FEDERAL MOTOR VEHICLE SAFETY

STANDARD (FMVSS) 208 WHICH SPECIFIES THE FORCES, DECELERATIONS, AND TIME HISTORIES ON A TEST DEVICE, A DUMMY, WHICH IS MEANT TO EXHIBIT ALL THE RELEVANT DYNAMIC RESPONSE CHARACTERISTICS OF THE HUMAN FRAME UNDER CRASH LOADING CONDITIONS. AT THIS TIME IN EUROPE THE COMMON VIEW IS THAT IT IS PREMATURE FOR A LARGE LEGISLATIVE STEP TO BE TAKEN, IN THE LIGHT OF THE PRESENT STATE OF KNOWLEDGE OF HUMAN TOLERANCES UNDER CRASH CONDITIONS, HOW THESE TOLERANCE LEVELS VARY WITH THE POPULATION AT RISK, AND HOW ACCURATELY A DUMMY REPRODUCES HUMAN RESPONSE. FOLLOWING THE DESIGN RULES ALREADY ENACTED IN EUROPE WILL BE THE NEXT GENERATION OF REGULATIONS WRITTEN IN TERMS OF PERFORMANCE STANDARD REQUIREMENTS, BUT STILL TAKING INTO ACCOUNT THE SPECIFIC CONTACTS VEHICLE OCCUPANTS MAKE WITH THE SEVERAL SUBSYSTEMS OF THE CAR. FMVSS 208 ELIMINATES ALL REFERENCE TO THE VEHICLE STRUCTURE AS SUCH, AND ALLOWS THE MANUFACTURER THE CHOICE OF COMBINATION OF RESTRAINT TYPE, VEHICLE GEOMETRY, AND VEHICLE STIFFNESS APPROPRIATE TO THE PARTICULAR PRODUCT. THE ULTIMATE RESULT IN EUROPE MAY WELL BE A TOTAL PERFORMANCE STANDARD ALONG THESE LINES, WITH THE ELIMINATION OF ALL REQUIREMENTS FOR SUBSYSTEM SPECIFICATION, BUT IT IS STILL SOME YEARS IN THE FUTURE. WITH THIS APPROACH, EACH EXISTING REGULATION IS BEING REVIEWED TO DECIDE HOW IT CAN BEST BE IMPROVED IN THE LIGHT OF EVOLVING BIOMECHANICAL KNOWLEDGE AND ACCIDENT FREQUENCY DATA, WITH THE ULTIMATE AIM OF INTEGRATING EACH REQUIREMENT INTO A TOTAL PERFORMANCE PACKAGE.

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Publ: HS-023 250, "INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR ACCIDENT AND TRAFFIC MEDICINE (6TH) PROCEEDINGS," MELBOURNE, 1977 P534-42  
1977; 9REFS  
Availability: IN HS-023 250

HS-803 066

#### SEMINAR ON TRAFFIC CASE ADJUDICATION SYSTEMS. ADMINISTRATOR'S GUIDE

SCHEDULING AND LOCATION OF A SEMINAR IS DISCUSSED, AND THE ADMINISTRATOR'S FUNCTIONS DESCRIBED, INCLUDING SUCH PRESEMINAR ACTIVITIES AS SELECTING PARTICIPANTS, RESOURCE PERSONNEL, AND INSTRUCTOR, DISSEMINATING INFORMATION ON THE SEMINAR'S OBJECTIVES AND APPROACH, AND PROVIDING NECESSARY FACILITIES, EQUIPMENT, SUPPLIES AND MATERIALS. ACTIVITIES INVOLVED IN CONDUCTING THE SEMINAR INCLUDE INTRODUCTIONS, GOAL SETTING, PROVIDING INFORMATION ON ADMINISTRATIVE DETAILS, PREVENTION OF DISTRACTIONS, AND SUMMING UP. POSTSEMINAR ACTIVITIES INCLUDE EVALUATION, SUMMARIZATION, AND FOLLOW-UP ACTIVITIES SUCH AS LEARNING THE

NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION, WASHINGTON, D.C. 20590

1978; 36P 16REFS

CLEARINGHOUSE TRAINING MATERIALS. SEE ALSO  
HS-803 067, "PARTICIPANT'S MANUAL," AND HS-803  
068, "INSTRUCTOR'S MANUAL."

Availability: GPO STOCK NO. 050-003-00306-9

HS-803 067

### SEMINAR ON TRAFFIC CASE ADJUDICATION SYSTEMS. PARTICIPANT'S MANUAL

THE SEMINAR IS DESIGNED TO IDENTIFY AND ANALYZE PROBLEMS IN A STATE'S TRAFFIC CASE ADJUDICATION SYSTEM AND TO DEVELOP AN AGENDA FOR SOLVING PROBLEMS. THE TRAFFIC LAW SYSTEM OF A STATE IS ANALYZED AND FUNCTIONAL FAILURES DISCUSSED, SUCH AS THOSE CONNECTED WITH PROCESSING ARREST BONDS, CONDUCTING NONAPPEARANCE PROCEEDINGS, PRETRIAL AND ADJUDICATIVE HEARINGS, AND IMPOSING SANCTIONS. OTHER FUNCTIONAL FAILURE AREAS INCLUDE APPEAL JUDGMENTS, NOTIFYING THE DEPT. OF MOTOR VEHICLES, MAINTAINING AND PROVIDING RECORDS, PROVIDING ADJUDICATION AND SANCTIONING REQUIREMENTS AND PROCEDURES, MONITORING AND CONTROLLING THE ADJUDICATIVE SYSTEM, EVALUATION OF THE SYSTEM'S EFFECTIVENESS, AND LAW ENFORCEMENT RELATIONSHIPS. THE REQUIREMENTS OF PROPOSED HWY. SAFETY STANDARDS, INCLUDING N-7, ARE DISCUSSED, AS IS THE APPLICATION OF N-7 REQUIREMENTS TO A STATE'S TRAFFIC CASE ADJUDICATION SYSTEM. THIS CAN BE ACCOMPLISHED BY USING THE UNIFORM TRAFFIC CITATION AND COMPLAINT DOCUMENTATION, BY IMPROVING THE TRAFFIC RECORDS SYSTEM, BY USING A PRESENCE INVESTIGATION PROCEDURE, BY DECRIMINALIZING CERTAIN TRAFFIC OFFENSES, BY USING TRAINED PERSONNEL, AND BY QUANTITATIVELY EVALUATING THE SYSTEM. A UNIFORM DRIVER'S LICENSE POLICY IS RECOMMENDED. THE N-7 STANDARD REQUIRES THAT TRAFFIC COURTS AND OTHER ADJUDICATIVE AGENTS BE FINANCIALLY INDEPENDENT OF THE REVENUES THEY COLLECT. SPECIFIC REQUIREMENTS OF THE N-7 STANDARD ARE DESIGNED TO CORRECT SUCH FAILURES AS DISREGARD OF VIOLATIONS, FAILURE TO APPEAR, IMPROPER DETERMINATION OF GUILT OR INNOCENCE, INAPPROPRIATE OR UNIMPLEMENTED SANCTIONS, LACK OF DECISIONMAKING DATA, LACK OF OR NONCOMPLIANCE WITH REQUIREMENTS AND PROCEDURES, OR LACK OF EVALUATION CONCERNING ATTAINMENT OF OBJECTIVES.

NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION, WASHINGTON, D.C. 20590  
1978; 108P 66REFS

CLEARINGHOUSE TRAINING MATERIALS. SEE ALSO  
HS-803 066, "ADMINISTRATOR'S GUIDE," AND HS-803  
068, "INSTRUCTOR'S MANUAL."

Availability: GPO STOCK NO. 050-003-00311-5

OBJECTIVES OF THE SEMINAR ARE OUTLINED, WITH DISCUSSION OF INSTRUCTIONAL STRATEGIES, ROLE OF THE INSTRUCTOR AND RESOURCE PERSONNEL, AND USE OF THE MANUAL. THE SEMINAR CONTENT IS OUTLINED AND SCHEDULED. EACH INSTRUCTIONAL UNIT IS PROVIDED WITH GUIDELINES AS TO METHOD, OBJECTIVES, SUBJECT MATTER, AND TECHNIQUE. LECTURE NOTES AND VU-GRAF MASTERS ARE PROVIDED FOR FOUR OF THE SEVEN UNITS. THE FIRST UNIT COVERS ANALYSIS OF A TRAFFIC ADJUDICATION SYSTEM, THE SECOND DISCUSSES COMMON FAILURES IN THE SYSTEM, FOLLOWED BY UNITS COVERING ANALYSIS OF FAILURES, APPLICATION OF NATIONAL STANDARDS, ESPECIALLY HWY. SAFETY STANDARD N-7, ADAPTATION OF N-7 REQUIREMENTS TO A PARTICULAR ADJUDICATION SYSTEM, THE PROBLEM-SOLVING RATIONALE BEHIND N-7 REQUIREMENTS, AND WAYS OF IMPROVING THE PRESENT ADJUDICATION SYSTEM IN A SPECIFIC LOCALITY.

NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION, WASHINGTON, D.C. 20590  
1978; 131P

CLEARINGHOUSE TRAINING MATERIALS. SEE ALSO  
HS-803 066, "ADMINISTRATOR'S GUIDE," AND HS-803  
067, "PARTICIPANT'S MANUAL".

Availability: GPO STOCK NO. 050-003-00307-7

HS-803 071

### INSERVICE TRAINING SEMINAR FOR THE DRIVER LICENSING ADMINISTRATIVE HEARING OFFICER. ADMINISTRATOR'S GUIDE

SEMINAR OBJECTIVES ARE DETAILED, THE NECESSARY MATERIALS SPECIFIED, AND PREPARATION PROCEDURES AND ACTIVITIES DESCRIBED. THE SEMINAR AGENDA ARE PRESENTED FOR EACH OF THE TWO DAYS. FOLLOWING THE INTRODUCTION OF LEADERS AND PARTICIPANTS, AND EXPLANATION OF THE PURPOSE AND SCOPE OF THE SEMINAR, THE HWY. SAFETY SYSTEM IS DISCUSSED AND BACKGROUND PROVIDED ON THE DRIVER LICENSING AGENCY HEARING AUTHORITY PROJECT. CRITICAL ELEMENTS AND SEQUENCE OF ACTIVITIES IN AN ADEQUATE RECORD ARE EXPLAINED, INCLUDING RULES OF EVIDENCE, TAKING OF TESTIMONY, AND OPINION WRITING. EXAMPLES OF PROGRESS MADE TOWARD ADEQUATE RECORD-KEEPING BY LOCAL DEPTS. OF MOTOR VEHICLES ARE DISCUSSED. HYPOTHETICAL SITUATIONS ARE POSED AND PARTICIPANTS ENGAGED IN PROBLEM SOLVING IN CONNECTION WITH SANCTION DECISIONS, FOLLOWED BY EXERCISES IN PRACTICAL APPLICATION OF DUE PROCESS. THE PROCESS OF DRIVER PROBLEM IDENTIFICATION IS DEMONSTRATED, ILLUSTRATING A NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION DIAGNOSTIC TOOL WHICH PROVIDES CATEGORICAL DRIVER PROFILES. AN EXERCISE IN INTERPERSONAL DYNAMICS ILLUSTRATES THE PROPER TECHNIQUES OF PARAPHRASING, PERCEPTION CHECKING, AND APPROPRIATE

QUESTIONING. SIMULATED HEARING SITUATIONS PROVIDE EXERCISE IN HEARING PROCEDURES, WITH EVALUATION OF LEGALITY, FAIRNESS, AND POTENTIAL EFFECT ON SAFETY. SUGGESTIONS ARE ELICITED FROM PARTICIPANTS ON ALTERNATIVES TO PRESENT SANCTIONS AND ON THE NEED FOR POLICY OR STATUTORY CHANGES. IT IS RECOMMENDED THAT ADMINISTRATORS READ THE INSTRUCTOR'S GUIDE FROM THIS SERIES FOR DETAILED INFORMATION ON ORIENTATION OF SEMINAR INSTRUCTORS.

NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION, WASHINGTON, D.C. 20590  
978; 16P 22REFS  
CLEARINGHOUSE TRAINING MATERIALS.  
PARTICIPANT'S MANUAL IS HS-803 070, AND  
INSTRUCTOR'S MANUAL IS HS-803 072.  
Availability: GPO STOCK NO. 050-003-00309-3

HS-803 181

#### AUTOMOBILE MARKETING STRATEGIES, PRICING, AND PRODUCT PLANNING. FINAL REPORT

THE DECISIONMAKING PROCESSES WERE INVESTIGATED CONCERNING MAJOR MODEL YEAR PRODUCT INTRODUCTIONS AND ALTERATIONS IN THE AUTOMOTIVE INDUSTRY, AS WERE TECHNIQUES OF PRICE POSITIONING, PRODUCT AND IMAGE POSITIONING, AND THE USE OF INCENTIVES AND OTHER PROMOTIONAL TOOLS. THE METHOD USED WAS TO ESTABLISH THE NEW MODELS INTRODUCED SINCE THE LAST TRADITIONAL YEAR (1959) IN THE AUTOMOTIVE INDUSTRY, AND TO DISCUSS THEIR FEATURES AND POSITIONING IN THE MARKET PLACE. SINCE 1959, THE MARKET HAS FEATURED A PROLIFERATION OF MODELS THAT HAVE SEGMENTED THE TOTAL MARKET, WITH FORMALIZED MARKETING RESEARCH INCREASINGLY USED TO IDENTIFY MARKET POTENTIAL OF A PROPOSED NEW MODEL. THE GENERAL AUTOMOBILE RETAIL PRICE LEVEL HAS GENERALLY BEEN CONTROLLED BY GENERAL MOTORS, ESPECIALLY THE CHEVROLET DIV. COMPETITIVE MODELS ARE PRICED VERY CLOSELY, WITH MORE LATITUDE IN PRICING LUXURY CARS. MARKET SEGMENTATION INIZING HAS INCREASED FROM TWO TO AT LEAST FIVE SIZES: SUBCOMPACT, COMPACT, INTERMEDIATE, STANDARD, AND LUXURY. A TREND TOWARD LARGER SALES OF SMALLER CARS CONTINUES. SALES INCENTIVES OFFERED TO DEALERS MAY BE AWARDS FOR OUTSTANDING PERFORMANCE OR CASH REBATES. INCENTIVES TO PURCHASERS TAKE THE FORM OF CASH REBATES OR AWARDS (FREE OPTIONAL EQUIPMENT).

by MARC L. HAGEMAN  
JOHN Z. DE LOREAN CORP., 100 W. LONG LAKE RD.,  
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DOT-TS-13509  
ept. No. DOT-TSC-NHTSA-77-6; 1978; 45P 4REFS  
ept. FOR MAR-JUN 1977.  
Availability: NTIS

HS-803 241

#### CRASHWORTHINESS OF MOTOR VEHICLES; A BIBLIOGRAPHY

THIS BIBLIOGRAPHY REPRESENTS LITERATURE ACQUIRED SINCE THE ESTABLISHMENT OF THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) IN JAN 1967 AND THROUGH MAY 1977 AS RELATED TO THE CRASHWORTHINESS OF MOTOR VEHICLES. IT IS COMPRISED OF NHTSA CONTRACT REPORTS, REPORTS OF OTHER ORGANIZATIONS CONCERNED WITH HIGHWAY SAFETY, AND ARTICLES FROM PERIODICALS IN RELATED FIELDS. CITATIONS FOLLOW THE FORMAT USED IN THE MONTHLY ABSTRACT JOURNAL, HIGHWAY SAFETY LITERATURE, AND ARE INDEXED BY A KEY-WORD-OUT-OF-CONTEXT (KWOC) LISTING, AUTHOR, CORPORATE AUTHOR, CONTRACT NUMBER, AND REPORT NUMBER.

by LOIS FLYNN, COMP.

NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION, TECHNICAL REFERENCE DIV., WASHINGTON, D.C. 20590  
Rept. No. SB-27; 1978; 210P REFS  
REPTS. FOR JAN 1967-MAY 1977.  
Availability: NTIS

HS-803 253

#### CALIBRATION PROCEDURES OF TEST DUMMIES FOR SIDE IMPACT TESTING. FINAL REPORT

RECOMMENDED TESTS, TESTING PROCEDURES, AND CALIBRATION CRITERIA WERE DEVELOPED AND ESTABLISHED BY WHICH TEST DUMMIES CAN BE CHARACTERIZED AND QUALIFIED FOR SIDE IMPACT COMPLIANCE TESTING. THESE TEST PROCEDURES WERE BASED ON A REVIEW OF AVAILABLE BIOMECHANICS LITERATURE, CAR CRASH TESTS, ACCIDENT INVESTIGATION DATA, AND IMPACT SLED TESTS. THE TESTS ARE SIMPLE TO PERFORM AND CAN BE DONE USING THE APPARATUS FOR EXISTING PART 572 FRONTAL TESTS. THE TESTS, EXCEPT FOR THE LATERAL NECK TEST, DO NOT REQUIRE DISASSEMBLY OF THE TEST DUMMY. THE TESTS ARE REPEATABLE AND SENSITIVE ENOUGH TO DETECT VARIABILITIES IN THE CONSTRUCTION AND RESPONSE OF THE DUMMY. IN EVALUATION TESTS OF THREE DUMMIES, THE TEST PROCEDURES PRODUCED REPEATABLE RESULTS, BUT VARIATIONS IN RESPONSE LEVELS WERE ALSO NOTED. THE MAJOR SOURCES OF VARIATION IN THE DIRECT IMPACT TESTS WERE CONSIDERED TO BE LACK OF CONTROL OF THE SIMULATED FLESH THICKNESS OVERLYING THE DUMMY SKELETAL STRUCTURES, AND, IN THE SHOULDER AND THORAX, STRUCTURAL LOAD PATH VARIATIONS. IN VIEW OF THE LIMITED KNOWLEDGE OF THE BIOMECHANICS OF LATERAL IMPACT RESPONSE AND THE VARIABILITIES IN TEST DUMMY CONSTRUCTION, THE TEST PROCEDURES AND CALIBRATION CRITERIA DEVELOPED BY THIS PROGRAM SHOULD BE CONSIDERED PRELIMINARY UNTIL ADDITIONAL BIOMECHANICAL INFORMATION AND MORE

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DOT-HS-6-0129

Rept. No. UM-HSRI-77-13; 1977; 211P 25REFS

REPT. FOR 20 NOV 1975-31 OCT 1976. INCLUDES

RESULTS OF CONTRACT DOT-HS-4-00921.

Availability: NTIS

HS-803 275

**PERFORMANCE CHARACTERISTICS OF  
AUTOMOTIVE ENGINES IN THE UNITED STATES.  
SECOND SERIES, REPORT NO. 1. 1976 CHEVROLET  
VEGA 140 CID [CUBIC INCH DISPLACEMENT] (2.3  
LITERS), 2V. INTERIM REPORT, AUGUST 1977**

A 1976 CHEVROLET VEGA 2.3-LITER, 140-CID (CUBIC INCH DISPLACEMENT) ENGINE WAS DYNAMOMETER TESTED TO DETERMINE FUEL CONSUMPTION AND EMISSIONS AT STEADY-STATE ENGINE OPERATING MODES. THE MAXIMUM TORQUE AND POWER OUTPUTS MEASURED IN THESE TESTS ARE IN AGREEMENT WITH THE MANUFACTURER'S SPECIFICATIONS. EMISSION RATES OF CARBON MONOXIDE (CO), HYDROCARBON (HC), AND NITROGEN OXIDES (NO<sub>x</sub>) ARE TYPICAL OF MODERN ENGINES EQUIPPED WITH EXHAUST GAS RECIRCULATION (EGR) SYSTEMS AND OXIDATION CATALYSTS. THE CARBURETOR WAS SET FOR LEAN OPERATION FOR LOW POWER OPERATION, ENABLING THE CATALYST TO CONTROL CO AND HC EFFECTIVELY. AT HIGHER POWER LEVELS, THE AIR/FUEL RATIO TENDED TO DECREASE, RESULTING IN LESS EFFECTIVE CATALYTIC TREATMENT OF CO AND HC. AT A GIVEN SPEED, NO<sub>x</sub> EMISSIONS TENDED TO REACH A MAXIMUM SOMEWHAT BELOW PEAK POWER. ABOVE THIS POWER LEVEL, FUEL-RICH ENGINE OPERATION RESULTED IN A DECREASE IN NO<sub>x</sub> EMISSIONS. THE TABULATED DATA PRESENTED ARE SUFFICIENT TO ESTABLISH STEADY-STATE MAPS OF FUEL CONSUMPTION AND EMISSION RATES FOR THE 1976 CHEVROLET VEGA 2.3-LITER ENGINE.

by T. W. CHAMBERLAIN; D. E. KOEHLER; K. R. STAMPER; W. F. MARSHALL  
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DOT-RA-76-23  
Rept. No. DOT-TSC-NHTSA-78-2; BERC/OP-77/47-1; PB-281 774; 1978; 64P  
Availability: NTIS

HS-803 276

**PERFORMANCE CHARACTERISTICS OF  
AUTOMOTIVE ENGINES IN THE UNITED STATES.  
SECOND SERIES, REPORT NO. 2. 1976 CHEVROLET  
305 CID [CUBIC INCH DISPLACEMENT] (5.0  
LITERS), 2V. INTERIM REPORT, AUGUST 1977**

A 1976 CHEVROLET 305-CID (CUBIC INCH DISPLACEMENT) V-8 ENGINE WAS DYNAMOMETER TESTED TO

THE MANUFACTURER'S SPECIFICATIONS. EMISSION RATES OF CARBON MONOXIDE (CO), HYDROCARBON (HC), AND NITROGEN OXIDES (NO<sub>x</sub>) ARE TYPICAL OF CONTROLLED LATE MODEL ENGINES. IN THE LOW POWER OUTPUT MODES, THE ENGINE'S OXIDATION CATALYST WAS EFFICIENT IN CONTROLLING CO AND HC. THE ENGINE'S EXHAUST GAS RECIRCULATION (EGR) SYSTEM WAS EFFECTIVE IN CONTROLLING NO<sub>x</sub> EMISSIONS. AS POWER OUTPUT WAS INCREASED, THE AIR/FUEL RATIO DECREASED, RESULTING IN LESS EFFECTIVE CATALYTIC TREATMENT OF CO AND HC. NO<sub>x</sub> EMISSIONS TENDED TO PEAK AT ABOUT 50% OF MAXIMUM POWER. BEYOND THIS POWER LEVEL, FUEL-RICH ENGINE OPERATION RESULTED IN A DECREASE IN NO<sub>x</sub> EMISSION RATES. THE TABULATED DATA PRESENTED ARE SUFFICIENT TO ESTABLISH STEADY-STATE MAPS OF FUEL CONSUMPTION AND EMISSION RATES FOR THE 1976 CHEVROLET 305-CID V-8 ENGINE.

by T. W. CHAMBERLAIN; D. E. KOEHLER; K. R. STAMPER; W. F. MARSHALL  
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DOT-RA-76-23  
Rept. No. DOT-TSC-NHTSA-78-3; BERC/OP-77/47-2; PB-281 775; 1978; 64P  
Availability: NTIS

HS-803 277

**PERFORMANCE CHARACTERISTICS OF  
AUTOMOTIVE ENGINES IN THE UNITED STATES.  
SECOND SERIES, REPORT NO. 3. 1977 CHRYSLER,  
225 CID [CUBIC INCH DISPLACEMENT] (3.7  
LITERS), 2V. INTERIM REPORT, AUGUST 1977**

EXPERIMENTAL DATA WERE OBTAINED IN DYNAMOMETER TESTS OF A 1977 CHRYSLER 225-CID ENGINE AT STEADY-STATE ENGINE-OPERATING MODES, TO DETERMINE FUEL CONSUMPTION AND EMISSIONS: HYDROCARBON (HC), CARBON MONOXIDE (CO), AND OXIDES OF NITROGEN (NO<sub>x</sub>). THE MAXIMUM TORQUE AND POWER OUTPUTS MEASURED IN THESE TESTS WERE IN AGREEMENT WITH THE MANUFACTURER'S SPECIFICATIONS. EMISSION RATES OF CO, HC, AND NO<sub>x</sub> WERE TYPICAL OF MODERN ENGINES EQUIPPED WITH EXHAUST-GAS-RECIRCULATION (EGR) SYSTEMS AND OXIDATION CATALYSTS. THE CARBURETOR WAS SET TO PROVIDE A FUEL-LEAN MIXTURE DURING LOW-POWER OPERATING, ENABLING THE CATALYST TO CONTROL CO AND HC EFFECTIVELY. AT HIGH-POWER LEVELS, THE AIR/FUEL RATIO TENDED TO DECREASE, RESULTING IN LESS EFFECTIVE CATALYTIC TREATMENT OF CO AND HC. OXIDES OF NITROGEN EMISSIONS INCREASED AT HIGHER POWER LEVELS. THE DATA ARE SUFFICIENT TO ESTABLISH STEADY-STATE MAPS OF FUEL CON-

vember 30, 1978

HS-803 297

MPTION AND EMISSION RATES FOR THE 1977  
RYSLER 225-CID ENGINE.

J. W. CHAMBERLAIN; D. E. KOEHLER; K. R.  
AMPER; W. F. MARSHALL  
ARTMENT OF ENERGY, BARTLESVILLE ENERGY  
C. CENTER, BARTLESVILLE, OKLA. 74003  
T-RA-76-23  
l. No. DOT-TSC-NHTSA-78-4; BERC/OP-77/48; PB-281  
1978; 62P  
Availability: NTIS

803 278

FORMANCE CHARACTERISTICS OF  
TOMOTIVE ENGINES IN THE UNITED STATES.  
ST SERIES, REPORT NO. 12. 1975 PERKINS  
SEL 247 CID [CUBIC INCH DISPLACEMENT] (4.0  
ERS) F.I. [FUEL INJECTION]. INTERIM  
PORT, JUNE 1977

EIMENTAL DATA WERE OBTAINED IN  
NAMOMETER TESTS OF A 1975 PERKINS 247 CID  
(CUBIC INCH DISPLACEMENT) DIESEL ENGINE TO  
TERMINE FUEL CONSUMPTION AND EMISSIONS  
HYDROCARBONS (HC), CARBON MONOXIDE (CO),  
OXIDES OF NITROGEN (NOX) AT STEADY-STATE  
GINE OPERATING MODES. BRAKE HORSEPOWER,  
ARQUE, AND BRAKE SPECIFIC FUEL CONSUMPTION  
RE PLOTTED AGAINST ENGINE SPEED (AT FULL  
K CONDITIONS). THE MAXIMUM BRAKE HOR-  
OWER AND PEAK TORQUE VALUES GENERALLY  
REE WITH MANUFACTURER'S SPECIFICATIONS.  
EL CONSUMPTION RATE WAS REPEATABLE FOR  
RIOR POWER OUTPUT LEVELS AT A GIVEN  
ED, AND IS NEARLY A LINEAR FUNCTION OF  
WER AT ANY GIVEN ENGINE SPEED. EMISSION  
TES OF CO, HC, AND NOX AS A FUNCTION OF  
WER SHOW RELATIONSHIPS SIMILAR TO THOSE  
OTHER DIESEL ENGINES EQUIPPED WITH THE  
RL COMBUSTION CHAMBER AND HAVING HIGH-  
ED CAPABILITY. EXHAUST-STREAM OPACITY  
OWED HIGHER LEVELS OF SMOKE WHEN THE EN-  
E WAS NOT PRODUCING ANY BRAKE POWER.  
E REPEATABILITY OF EMISSION RATES, FUEL  
NSUMPTION, SMOKE LEVELS, AND ENGINE PER-  
RMANCE WAS SATISFACTORY FOR THE PURPOSES  
THESE TESTS.

W. F. MARSHALL; K. R. STAMPER  
ARTMENT OF ENERGY, BARTLESVILLE ENERGY  
C. CENTER, P.O. BOX 1398, BARTLESVILLE, OKLA.  
3  
T-RA-75-10  
l. No. DOT-TSC-NHTSA-78-5; BERC/OP-77/28-12; PB-  
777; 1978; 37P  
Availability: NTIS

803 279

FORMANCE CHARACTERISTICS OF  
TOMOTIVE ENGINES IN THE UNITED STATES.  
ST SERIES, REPORT NO. 13. 1975 AMERICAN

MOTORS, 258 CID [CUBIC INCH DISPLACEMENT]  
(4.2 LITERS) 1V. INTERIM REPORT, JUNE 1977

EXPERIMENTAL DATA WERE OBTAINED IN  
DYNAMOMETER TESTS OF A 1975 AMERICAN MO-  
TORS 258-CID (CUBIC INCH DISPLACEMENT) PRODUC-  
TION 1V ENGINE TO DETERMINE FUEL CONSUMP-  
TION AND EMISSIONS OF HYDROCARBON (HC), CAR-  
BON MONOXIDE (CO), AND OXIDES OF NITROGEN  
(NOX) AT STEADY-STATE ENGINE OPERATING  
MODES. THE MAXIMUM BRAKE HORSEPOWER OUT-  
PUT AND PEAK TORQUE PRODUCED BY THE TEST  
ENGINE WERE LESS THAN MANUFACTURER'S  
SPECIFICATIONS. THE PEAK TORQUE DID OCCUR AT  
THE PRESCRIBED ENGINE SPEED AND COINCIDED  
WITH THE MINIMUM BRAKE SPECIFIC FUEL CON-  
SUMPTION. AIR/FUEL (A/F) RATIO WAS MAINTAINED  
AT LEAN CONDITIONS FOR ALL ENGINE SPEEDS, EX-  
CEPT FOR ENRICHMENT NEAR WIDE-OPEN THROT-  
TLE (WOT). FUEL CONSUMPTION WAS FOUND TO BE  
NEARLY A LINEAR FUNCTION OF POWER AT LIGHT  
TO MODERATE LOADS. THE FUEL CONSUMPTION AT  
LOW ENGINE SPEEDS NEAR WOT, HOWEVER, IN-  
DIATES THAT THE MAXIMUM FUEL CONSUMPTION  
MIGHT OCCUR AT 90% OF MAXIMUM LOAD. THIS  
COULD POSSIBLY BE DUE TO FUEL-METERING INAC-  
CURACIES, OR THE FACT THAT THE A/F RATIO IS  
CLOSER TO STOICHIOMETRIC AT WOT. EMISSIONS  
OF HC AND CO WERE CONTROLLED AT LIGHT TO  
MODERATE LOADS FOR ALL ENGINE SPEEDS. NOX  
EMISSIONS EXHIBITED PEAK VALUES WHEN THE  
A/F RATIO WAS NEAR STOICHIOMETRIC. THE RE-  
PEATABILITY OF EMISSION RATES, FUEL CONSUMP-  
TION, AND PERFORMANCE DATA WAS SATISFACTO-  
RY FOR THE PURPOSES OF THESE TESTS.

by W. F. MARSHALL; K. R. STAMPER  
DEPARTMENT OF ENERGY, BARTLESVILLE ENERGY  
C. CENTER, P.O. BOX 1398, BARTLESVILLE, OKLA.  
74003  
DOT-RA-75-10  
Rept. No. DOT-TSC-NHTSA-78-6; BERC/OP-77/29; 1978; 38P  
Availability: NTIS

HS-803 297

MATERIALS DEVELOPMENT OF UNIFORM  
GUIDELINES. MOTOR VEHICLE INSPECTION  
REPORT. FINAL REPORT

ISSUES IDENTIFIED BY THE NATIONAL HWY. TRAF-  
FIC SAFETY ADMINISTRATION WERE EXPLORED  
AND GUIDELINES DEVELOPED FOR STATE ACTION.  
UNIFORM GUIDELINES FOR MOTOR VEHICLE  
SAFETY EQUIPMENT THAT SHOULD BE INSPECTED  
PERIODICALLY DESIGNATE BRAKE COMPONENTS,  
WHEELS, TIRES, STEERING AND SUSPENSION COM-  
ONENTS, FUEL SYSTEM, EXHAUST SYSTEM,  
LIGHTING AND SIGNAL COMPONENTS, VISIBILITY  
ITEMS, AND BODY COMPONENTS. A MODEL ODOME-  
TER DISCLOSURE PROCEDURES PROGRAM IS RECOM-  
MENDED. STATE PROCEDURES ARE OUTLINED FOR  
IDENTIFYING PROBLEM DRIVERS, AS IS A MODEL  
STATE CLASSIFIED DRIVER LICENSING PROGRAM.

ADMINISTRATORS, 1201 CONNECTICUT AVE., N.W.,  
SUITE 910, WASHINGTON, D.C. 20036  
DOT-HS-6-01438  
1977; 273P 11REFS  
REPT. FOR JUL 1976-NOV 1977. SUBTITLE ON TITLE  
PAGE: "AN AAMVA RECOMMENDED UNIFORM  
GUIDELINE OF MOTOR VEHICLE SAFETY  
EQUIPMENT WHICH SHOULD BE INSPECTED ON A  
PERIODIC BASIS."  
Availability: NTIS

HS-803 310

**SOLID STATE DATA ACQUISITION AND  
PROCESSING SYSTEM (SSDAPS), VOL. 1: SYSTEM  
SUMMARY; VOL. 2: DESCRIPTION, OPERATION,  
AND VERIFICATION TEST REPORT. FINAL  
REPORT**

A PORTABLE DATA ACQUISITION AND ANALYSIS SYSTEM IS DESCRIBED WHICH WAS DESIGNED FOR STUDIES OF VEHICLE DYNAMICS, BRAKING, AND DRIVER BEHAVIOR. IT CONSISTS OF A FULL COMPLEMENT OF INSTRUMENTATION SENSORS; DATA ACQUISITION AND SIGNAL CONDITIONING MODULES; 62 CHANNEL FM/VHF DIGITAL TELEMETRY (46 ACTIVE AT THIS TIME); AND BASE STATION WITH PDP-11 MINICOMPUTER, TELETYPE, AND DIGITAL MAGNETIC TAPE DRIVE. SEVERAL UNIQUE FEATURES INCLUDE ONBOARD COMPUTATIONS OF SIDESLIP VELOCITY AND LATERAL POSITION, ROAD REFERENCED ACCELERATIONS, AND DRIVE LINE TORQUE, PLUS AN INTERACTIVE DRIVER DISPLAY PANEL. A USER'S MANUAL IS INCLUDED WHICH CONTAINS, IN ADDITION TO A DESCRIPTION OF THE SYSTEM, THE FOLLOWING INFORMATION: INSTRUMENTATION CHECKOUT AND OPERATION, BASE STATION CHECKOUT AND OPERATION, AND VERIFICATION TESTS.

by ARTHUR A. BLAUVELT; RICHARD A. PETERS;  
DUANE T. MCRUER; RICHARD H. KLEIN  
SYSTEMS TECHNOLOGY, INC., 13766 S. HAWTHORNE  
BLVD., HAWTHORNE, CALIF. 90250  
DOT-HS-5-01212

Rept. No. TR-1067-1-(1-2); 1977; 96P 1REF  
VOL. 3 (HS-803 311) CONTAINS SUPPORTING  
TECHNICAL INFORMATION ON INSTALLATION,  
CALIBRATION, AND MAINTENANCE OF THE SYSTEM.  
Availability: NTIS

HS-803 343

**VEHICLE INTEGRATION AND EVALUATION OF  
ADVANCED RESTRAINT SYSTEMS - RESTRAINT  
SYSTEMS ANALYSES. FINAL REPORT**

SLED TESTS AND VEHICLE CRASH TESTS WERE CONDUCTED IN ORDER TO EVALUATE THE PERFORMANCE OF FOUR ADVANCED RESTRAINT SYSTEMS IN A COMPACT SIZE AUTOMOBILE (1976 VOLVO 244). THE RESTRAINT SYSTEMS CHOSEN WERE: ADVANCED DRIVER AIRBAG SYSTEM; ADVANCED PASSENGER AIRBAG SYSTEM; FORCE-

DICATED A TIE BETWEEN THE AIRBELT AND RIGHT FRONT PASSENGER SYSTEM, FOLLOWED BY THE DRIVER AIRBAG AND THE FORCE-LIMITED TWO-INCH BELT SYSTEMS. ONLY THE FORCE-LIMITED TWO-INCH BELT FAILS TO MEET THE HEAD INJURY CRITERION (HIC) REQUIREMENT FOR THE FULL FRONTAL IMPACT MODE, WHICH IS THE ONLY MODE TO TEST THE SYSTEMS AT NEAR OR ABOVE CRITERIA LIMITS. THE SURVIVABILITY LIMIT FOR THE FIRST TWO SYSTEMS IS OVER 50 MPH, SHADING DOWN TO LESS THAN 48 MPH FOR THE LEAST EFFECTIVE SYSTEM. ALL SYSTEMS ARE "CHEST CRITICAL" FOR ALL IMPACT MODES, EXCEPT FOR THE FORCE-LIMITED TWO-INCH BELT SYSTEM, WHICH IS "HEAD CRITICAL" FOR THE FRONTAL MODE, AND "CHEST CRITICAL" FOR THE OFFSET AND OBLIQUE MODES. ALL FOUR SYSTEMS TESTED SHOWED A PERFORMANCE LEVEL FAR GREATER THAN FMVSS 208 REQUIREMENTS. IT IS RECOMMENDED THAT THESE SYSTEMS BE "PRODUCTIONIZED" AND RETESTED FOR EVENTUAL INSTALLATION IN PRODUCTION VEHICLES.

by MICHAEL U. FITZPATRICK  
FITZPATRICK ENGINEERING, 490 RANCHITO VISTA  
RD., SANTA BARBARA, CALIF. 93108  
DOT-HS-6-01307; NHTSA-8-0147  
1977; 204P  
REPT. FOR OCT 1977-FEB 1978. INCLUDES RESULTS OF  
CONTRACTS DOT-HS-5-01215 AND DOT-HS-4-00917.  
Availability: NTIS

HS-803 362

**AUTOMOTIVE FUEL ECONOMY CONTRACTORS'  
COORDINATION MEETING, APRIL 24-26, 1978.  
SUMMARY REPORT**

SUMMARIES ARE PROVIDED OF THE INVITED PRESENTATIONS ON THE RESEARCH SAFETY VEHICLE, AND FROM THE DEPT. OF ENERGY AND THE ENVIRONMENTAL PROTECTION AGENCY. ALSO INCLUDED ARE SUMMARIES OF PRESENTATIONS COVERING A PROGRAM OVERVIEW, INTEGRATED TEST VEHICLES, VEHICLE WEIGHT REDUCTION, AND AUTOMOBILE TRANSMISSIONS. OTHER TOPICS INCLUDE MANUFACTURING, MAINTENANCE AND COSTS, SPARK IGNITION AND DIESEL ENGINES, FUEL ECONOMY REVIEWS, AND INDUSTRIAL ANALYSIS. PRESENTATIONS WERE ALSO MADE ON MANUFACTURER IMPACTS AND ALTERNATIVES, FUEL CONSERVATION ON THE ROAD, THE CONSUMER, AND AUTO DEMAND. REPRODUCTIONS OF VISUAL AIDS (CHARTS, PHOTOGRAPHS, DRAWINGS, ETC.) ARE INCLUDED.

NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION, TECHNOLOGY ASSESSMENT DIV.,  
WASHINGTON, D.C. 20590  
1978; 940P  
Availability: NTIS

November 30, 1978

HS-803 368

HS-803 364

**RESEARCH SAFETY VEHICLE, PHASE 3. STATUS REPORT NO. 8, 1 MARCH TO 30 APRIL 1978**

A REVISION OF THE FRONT RAIL DESIGN OF THE RESEARCH SAFETY VEHICLE (RSV) WAS COMPLETED AND DEVELOPED THROUGH STATIC TESTS TO PROVIDE A SOFTER CRUSH RESISTANCE IN ZONE 2, AND SUPERIOR RESISTANCE TO BUCKLING AND PASSENGER COMPARTMENT INTRUSION. THE REVISED RAIL AND FRONT STRUCTURE DESIGN WAS VALIDATED BY TEST NO. 9 (STATIONARY BARRIER CRASH AT 44.1 MPH). LOW SPEED TESTS NOS. 2 AND 11 WERE COMPLETED, AS WAS THE INITIAL 40 MPH FRONT-TO-SIDE CRASH TEST OF TWO RSV'S (TEST NO. 6). REPORTS ON STATIC CRUSH TESTS AND DYNAMIC TESTS NOS. 3 AND 5 WERE PUBLISHED AND SUBMITTED TO THE SPONSOR. A REPORT ON THE COMPLETION OF THE AIR BELT RESTRAINT SYSTEM WAS PREPARED FOR PUBLICATION AND AN INVESTIGATION WAS BEGUN OF THE EFFECT OF PARAMETER MODIFICATIONS ON AIR BELT AND AIR BAG RESTRAINT SYSTEMS. THE DRIVEABILITY AND HANDLING REPORT WAS ALSO COMPLETED. THE PROTOTYPE FOR THE PHASE 4 VEHICLE FRONT END WAS COMPLETED AND DELIVERED. ARRANGEMENTS WERE MADE WITH CREATIVE INDUSTRIES TO FABRICATE TEN PHASE 4 VEHICLES AND TO PROVIDE APPROPRIATE SPARE PARTS. THE VEHICLES INCLUDE TWO PEDESTRIAN CRASH BUCKS, TWO DRIVEABLE CARS FOR SYSTEMS INVESTIGATION, FOUR CRASH VEHICLES, AND TWO RSV DEMONSTRATORS. THE REMAINING INTERIOR TOOLING AND TRIM ITEMS WERE ORDERED FROM CHRYSLER. PRODUCTION OF PHASE 4 VEHICLES IS UNDERWAY. REVISED SCHEDULING AND COST TABLES ARE PRESENTED. SUPPORT DOCUMENTS INCLUDE SPECIFICATIONS FOR CHRYSLER RSV TAIL LIGHT (IN FRENCH WITH TRANSLATION), SAE STANDARD J576D ON PLASTIC LENS AND REFLECTOR MATERIAL, SAE STANDARD J578B ON COLOR SPECIFICATION FOR SIGNAL LIGHTS, SAE STANDARD J575F ON TESTS FOR MOTOR VEHICLE LIGHTING DEVICES AND COMPONENTS, AND AN UNIDENTIFIED TABLE IN FRENCH ON RUBBER PADDING.

CALSPAN CORP., BUFFALO, N.Y. 14221

DOT-HS-7-01551

Rept. No. PR-8; 1978; 122P

Availability: NHTSA

HS-803 365

**RSV - PHASE 3 [RESEARCH SAFETY VEHICLE].  
PROGRESS REPORT NO. 6 FOR DECEMBER 1977  
AND JANUARY 1978**

ANALYTICAL AND EMPIRICAL DATA WERE PRODUCED, SUPPORTING AN HYPOTHESIS TO ACCOUNT FOR INSTABILITY OF THE COLLAPSIBLE STEERING COLUMN IN THE RESEARCH SAFETY VEHICLE (RSV). FRICTION FORCES IN THE COLUMN BUSHINGS WERE FOUND TO CAUSE THE UNDESIRABLE STROKING CHARACTERISTICS AND RESULTING HIGH CHEST G'S. SIGNIFICANT CHANGES IN SYSTEM WEIGHTS ARE DESCRIBED, RESULTING IN A

REVISED ESTIMATE OF 2248 LBS CURB WEIGHT. DOOR WEIGHT ESTIMATES ARE BEING REVISED, REFLECTING A 25 LB LOSS IN WEIGHT DUE TO THE USE OF ALUMINUM. A COMPUTER ANALYSIS WAS MADE OF THE UPPER DOOR STRUCTURE TO PROVIDE FOR AN IMPROVED DOOR LATCH DESIGN AND ALUMINUM WAS FOUND TO HAVE ACCEPTABLE STRENGTH. THE BUDD CO.'S BUILD 5 DESIGN OF THE RSV ROOF STRUCTURE WAS MODIFIED TO IMPROVE ITS STRENGTH. IN THE FUEL SYSTEM, THE VENT LINE SIZE WAS INCREASED AND THE FUEL TANK COVER REDESIGNED. IN THE SUSPENSION SYSTEM, STRUCTURAL DOUBLERS WERE ADDED TO THE REAR CRADLE MOUNT AND SUSPENSION ARMS. THE ANGLE OF THE ENGINE STABILIZER STRUT IS BEING RELOCATED. THE HEATER WAS RELOCATED, REQUIRING ADDITIONAL TOOLING CHANGES IN THE HEATER PLENUMS. AN IMPACT PAD AND SUPPORT BRACKET WAS INCORPORATED UNDER THE STEERING COLUMN. SOME MODIFICATIONS WERE MADE ON TRIM, REAR PASSENGER RESTRAINTS, BODY GLOVE, WHEELS, AND TIRES. FIVE ENERGY MANAGEMENT BUMPER SYSTEMS WERE TESTED (NO DAMAGE IN AN 8 MPH BARRIER IMPACT), LEADING TO THE DEVELOPMENT OF A 10 MPH NO-DAMAGE NOSE AND BUMPER. THE ASSEMBLY AND BALLASTING, AND INSTRUMENTATION OF THE M4-2 RIDE AND HANDLING TEST VEHICLE WERE COMPLETED. THE TURBOCHARGED ACCORD ENGINE IS BEING MODIFIED FOR INSTALLATION IN THE M4-7 TEST BED. COMPUTER ANALYSIS WAS MADE OF THE SHIFT ALGORITHM OF THE AUTOMATED MANUAL TRANSMISSION. DESIGN OF THE VACUUM SERVO SYSTEM FOR ACTIVATING THE CLUTCH HAS BEEN COMPLETED. SYSTEMS FABRICATION FOR VEHICLES M4-3, M4-4, M4-5, AND M4-6 IS SUMMARIZED. THE EVOLUTION OF THE STRUCTURAL DESIGN OF THE LARGE RESEARCH SAFETY VEHICLE (LRSV) IS REVIEWED, AND PROGRESS MADE ON VARIOUS SYSTEMS OUTLINED. THE INITIAL DATA BASE FOR INVENTORY, BILL OF MATERIALS, AND COST CONTROL MANAGEMENT OF THE LRSV WAS ESTABLISHED.

MINICARS, INC., 35 LA PATERA LANE, GOLETA,  
CALIF. 93017  
DOT-HS-7-01552  
Rept. No. PR-6; 1978; 114P  
Availability: CORPORATE AUTHOR

HS-803 368

**ALCOHOL/SAFETY PUBLIC INFORMATION  
MATERIALS CATALOG. NO. 3, SUPP. 1**

PROMOTIONAL MATERIALS ARE GROUPED UNDER 13 BROAD SUBJECT HEADINGS, UNDER WHICH ORGANIZATIONS PRODUCING THE MATERIALS ARE LISTED ALPHABETICALLY. THE MATERIALS ARE LISTED BY ACCESSION NUMBER UNDER THE SPONSORING ORGANIZATION, WITH FORMAT INDICATED. A LIST OF KEY WORDS (DESCRIPTORS) IS PROVIDED. ARTICLES AND REPORTS ARE CATALOGUED BY TITLE, WITH ORGANIZATION, AUTHOR, AND JOURNAL INDICES PROVIDED. THESE MATERIALS ARE ALSO INDEXED BY ACCESSION NUMBER UNDER 13 SUBJECT AREAS. THE FOLLOWING SUBJECT INDICES

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ARE USED: ALCOHOLISM AS A DISEASE; ALTERNATIVES TO DRUNK DRIVING; DRUGS OTHER THAN ALCOHOL; INDUSTRIAL/ORGANIZATIONAL ALCOHOLISM; LEGAL ASPECTS; MINORITY GROUPS; PHYSIOLOGICAL IMPAIRMENT; GENERAL INFORMATION; RESPONSIBLE DRINKING; SOCIAL DRINKING; THREAT; TREATMENT; AND YOUNG PEOPLE.

by ANN C. GRIMM, COMP.  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
INST., ANN ARBOR, MICH. 48109  
NHTSA-6-5571  
Rept. No. UM-HSRI-77-2; 1977; 64P REFS  
Availability: NTIS

HS-803 377

#### **DRIVER PERFORMANCE TESTS: THEIR ROLE AND POTENTIAL. FINAL REPORT**

THE ROLE OF STATE ROAD TESTS IS EXAMINED, EMPHASIZING THEIR USEFULNESS AS SCREENING DEVICES, DIAGNOSTIC TOOLS, AND EDUCATIONAL INSTRUMENTS, AND THE SHORT AND LONG TERM RESEARCH NEEDS IN THIS AREA ARE IDENTIFIED. LITERATURE ON PERFORMANCE TESTS WAS REVIEWED, AS WAS PERFORMANCE TESTING IN OTHER MODES OF TRANSPORTATION. AFTER AN INTERIM REPORT WAS PREPARED, A CONFERENCE WAS HELD TO CONSIDER THE PRESENT AND POTENTIAL ROLES OF STATE ROAD TESTS AND TO IDENTIFY RESEARCH NEEDS. CONFERENCE PARTICIPANTS REPRESENTED EXPERTISE IN OPERATIONS, THE LAW, DRIVER LICENSE RESEARCH, AND HUMAN PERFORMANCE RESEARCH. A FINAL REPORT SUMMARIZED THE CURRENT STATE OF THE ART AND IDENTIFIED SHORT AND LONG TERM RESEARCH NEEDS IN DRIVER PERFORMANCE TESTING. THE ROAD TEST IS CURRENTLY USED PRIMARILY AS A CRITERION TO GUARANTEE THAT BEGINNING DRIVERS HAVE ACHIEVED A MINIMAL LEVEL OF SKILL. THE ROLE OF THE TEST FOR DIAGNOSTIC AND EDUCATIONAL PURPOSES IS LESS CLEAR. SHORT TERM RESEARCH SHOULD FOCUS FIRST ON COMPILED A ROAD TEST BASED ON THE BEST ELEMENTS OF AVAILABLE CAREFULLY DEVELOPED PERFORMANCE TESTS. OTHER SHORT TERM RESEARCH SHOULD EXAMINE ROUTE SELECTION, TESTS FOR OPERATORS OF MOTORCYCLES AND HEAVY TRUCKS, USE OF THE TEST AS A MOTIVATOR, AND THE DEMOGRAPHY OF EXISTING STATE ROAD TESTS. LONG TERM RESEARCH SHOULD FIRST IDENTIFY THOSE HUMAN PERFORMANCE PARAMETERS THAT DIFFERENTIATE BETWEEN NOVICE AND EXPERIENCED DRIVERS. A MEANINGFUL LICENSING PROGRAM, BASED ON INFORMATION RESULTING FROM THIS RESEARCH, SHOULD BE COORDINATED WITH DRIVER TRAINING, HIGHWAY ENGINEERING AND VEHICLE DESIGN.

by PATRICIA F. WALLER; LIVIA K. LI; ROBERT G. HALL; JANE C. STUTTS  
UNIVERSITY OF NORTH CAROLINA, HWY. SAFETY RES. CENTER, CHAPEL HILL, N.C. 27514  
DOT-HS-7-01698  
1978; 152P 110REFS  
REPT. FOR 15 SEP 1977-15 MAR 1978.  
Availability: NTIS

HSL 78-11

HS-803 378

#### **MULTIDISCIPLINARY ACCIDENT INVESTIGATION. IN-DEPTH CASE REPORT MV-4-25. DUMPRUCK AND TRACTOR - FIRE FATALITY**

AN ACCIDENT INVOLVING A 1973 GENERAL MOTORS DUMP TRUCK (V-2) AND A 1973 DIESEL FORD TRACTOR WITHOUT TRAILER (V-1) OCCURRED ON INTERSTATE ROUTE 495 NEAR WASHINGTON, D.C. ON 19 APR 1977 AT 10:15 P.M. V-2 WAS PARKED AND ABANDONED BY ITS DRIVER AFTER EXPERIENCING ELECTRICAL PROBLEMS AT APPROXIMATELY 4:00 P.M. MORE THAN SIX HOURS LATER, THE TRACTOR WAS HEADED SOUTH ON ROUTE 495 WHEN IT DRIFTED ONTO THE SHOULDER AND IMPACTED THE LEFT REAR OF V-2. V-1 ROTATED MORE THAN 180° AS IT CONTINUED TRAVELLING SOUTH ALONG THE RIGHT LANE AND SHOULDER, SPILLING DIESEL FUEL FROM ITS RUPTURED RIGHT-HAND TANKS. WITNESSES REPORT THAT AN EXPLOSION OCCURRED AT IMPACT. THE DRIVER OF V-1 WAS AIDED BY PASSERSBY AS HE STOOD ON FIRE IN THE SECOND SOUTHBOUND LANE. THE CAB AND ENGINE COMPARTMENT WERE FULLY INVOLVED WHEN FIRE EMERGENCY VEHICLES ARRIVED. THE DRIVER OF V-1 WAS TAKEN, BY AMBULANCE, TO FAIRFAX HOSPITAL AND THEN TRANSFERRED TO THE WASHINGTON HOSPITAL CENTER BURN UNIT, WHERE HE DIED THREE DAYS LATER AS A RESULT OF HIS EXTENSIVE BURNS (ABBREVIATED INJURY SCALE 6).

by GEORGE LITTLE; G. COOPerman; STEPHANIE SHAFER  
DYNAMIC SCIENCE, INC., 6845 ELM ST., SUITE 203,  
MCLEAN, VA. 22101  
DOT-HS-6-01346  
Rept. No. MV-4-25; 1978; 103P  
REPT. FOR 20 NOV 1976-20 JAN 1978.  
Availability: REFERENCE COPY ONLY

HS-803 380

#### **SAFETY BELT USAGE IN THE TRAFFIC POPULATION. MONTHLY PROGRESS REPORT NO. 6, MAY 10, 1978**

THE OBSERVATION PROGRAM OF SAFETY BELT USAGE IN DALLAS, TEX., MINNEAPOLIS, MINN., SEATTLE, WASH., AND PROVIDENCE, R.I. WAS CONDUCTED ON SCHEDULE WITHOUT UNTOWARD INCIDENTS. RESULTS FROM THE OBSERVATION FORMS WERE HAND TABBED AND COMPARED TO THE KEY PUNCHED AND COMPUTER DATA, NO ERRORS BEING EVIDENT. DATA ARE BROKEN DOWN INTO THE FOLLOWING CATEGORIES: LAP AND SHOULDER BELTS USED, LAP ONLY USED, AND TOTAL USED, BY TYPE OF SYSTEM; GENDER, AGE, AND PRIMARY ROADS VERSUS FREEWAY EXITS; PASSIVE VS. ACTIVE SYSTEMS FOR VOLKSWAGEN RABBITS; CITY VS. SUBURB; AUTOMOBILE MANUFACTURER; AND CITY, OBSERVER OR REGION, AND MONTH OF OBSERVATION. SUPERVISORS STRESSED THE NEED FOR CARE IN IDENTIFYING THE THREE TYPES OF RESTRAINT

November 30, 1978

HS-803 380

SYSTEMS. TWO FIELD INSPECTION TRIPS WERE  
MADE.

by ALBERT WESTEFELD; BENJAMIN PHILLIPS  
OPINION RES. CORP., N. HARRISON ST., PRINCETON,  
N.J. 08540  
DOT-HS-7-01736  
Rept. No. PR-6; 1978; 8P  
Availability: CORPORATE AUTHOR



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## **INDEX to ABSTRACTS**



## KWOC Title Index

### ABBREVIATED

AN ANALYSIS OF 115 KILLED AND 205 SEVERELY INJURED (OAIS [ABBREVIATED INJURY SCALE] GREATER THAN OR EQUAL TO 2) SEAT BELT USERS [SWITZERLAND]

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### ACQUISITION

SOLID STATE DATA ACQUISITION AND PROCESSING SYSTEM (SSDAPS), VOL. 1: SYSTEM SUMMARY; VOL. 2: DESCRIPTION, OPERATION, AND VERIFICATION TEST REPORT. FINAL REPORT

HS-023 310

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A SIMULATION ANALYSIS OF PEDESTRIAN ACTUATED TRAFFIC SIGNAL CONTROL SYSTEM

HS-023 198

CONTROL STRATEGIES FOR SIGNALIZED DIAMOND INTERCHANGES. TECHNOLOGY SHARING REPORT. TRAFFIC ENGINEERING METHOD, FHWA DESIGN MANUAL METHOD, FULLY ACTUATED CONTROL METHOD, MICRO-PROCESSOR CONTROL METHOD

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74003**

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